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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Notice Respecting the "Wrinkle Department," Western Gas Association.

OFFICE OF THE SECRETARY, NEW ALBANY, IND., Feb. 10, 1896.

Contributions to the "Wrinkle Department," of which Mr. Geo. T. Thompson, of St. Louis, is editor, should be sent to him not later than March 20. The "Wrinkle Department" is a distinctive and valuable feature of the meetings of the Western Gas Association. Its success has been due wholly to the personal solicitations of its editor, who has been persistent in his efforts to collect a valuable contribution. This year it is hoped that contributors will voluntarily and promptly send Mr. Thompson their "Wrinkles" for the Chattanooga meeting.

JAMES W. DUNBAR, Sec'y.

[OFFICIAL NOTICE.]

March Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, Feb. 28, 1896.

The March meeting of the Society of Gas Lighting will be held in the Arena, No. 39 West 31st street, New York City, at 3 P.M. of Thursday, March 12.

FRED. S. BENSON, Sec'y.

[OFFICIAL NOTICE.]

March Meeting, Guild of Gas Managers.

OFFICE OF THE SECRETARY, Feb. 28, 1896.

The March meeting of the Guild of Gas Managers will be held in Young's Hotel, Boston, at noon, Saturday, March 14.

A. K. QUINN, Sec'y.

[OFFICIAL NOTICE.]

Twelfth Annual Meeting of the Ohio Gas Light Association.

OFFICE OF THE SECRETARY, COLUMBUS, O., March 2, 1896.

The following is a list of papers to be read at our twelfth annual meeting, which will be held in Cincinnati, O., Wednesday and Thursday, March 18 and 19, 1896:

"Utilizing Gas Liquor in Small Gas Plants," by Mr. B. P. Holmes, Youngstown, O.

"Dots and Dashes," by Mr. E. H. Jenkins, Covington, Ky.

"Mains and Services; their Extension into New Territory," by Mr. Geo. Light, Dayton, O.

"Selling Gas," by Mr. Henry L. Doherty, Columbus, O.

"Ventilation of Gas Heated Rooms," by Mr. Donald McDonald, Louisville, Ky.

It is expected that unusual interest will be given to the Thursday morning session, to which no one but members of the Association will be admitted, and at which time especial attention will be given to the "Question Box," to which all are requested to contribute.

The Grand Hotel, where the sessions will be held, is located at the corner of Fourth street and Central avenue, and is conveniently reached from all railroad depots. The Columbia avenue cars run direct to the hotel from the Pennsylvania and C. H. and D. depots, and passengers arriving at the Grand Central station have only to cross the street to take an elevator which will land them on the office floor of the hotel. The hotel is run on both the American and European plan, and the rates will be as follows: American plan, $3 per day and upwards; European plan, $1.50 per day and upwards.

Accommodations can be obtained at other hotels, as follows: Gibson House, $3 to $5 per day; Burnett House, $3 per day; Palace Hotel, $2 and $2.50 per day; Dennison Hotel, $1.50 and $2 per day.

Those contemplating attending the meeting are advised to secure their rooms in advance.

Membership application blanks can be obtained from the Secretary.

A. P. LATHROP, Sec'y.

BRIEFLY TOLD.

THE NEW ENGLAND ASSOCIATION'S MEETING.—This week we commence our official report of the proceedings of the 26th annual meeting of the New England Association of Gas Engineers, and we promise that it will be complete and accurate. The telegraphic dispatches printed in our issue for last week told tersely the main points of the session, and we have great satisfaction now in emphasizing and reaffirming our correspondent's closing sentence, which was, "The meeting is an excellent one." In every respect the meeting was successful; for propitious weather, excellent hotel and meeting room accommodations, a representative attendance, capable executives, and an exceptionally interesting technical programme were its environments, and features. In fact the meeting and its results go to prove that age has in no sense dulled the life of the New England Association for active and effective technical work. President Lamson's address was notable for many clear cut and plainly put points, prominent amongst which are two that appeal directly to every gas maker and gas investor of to-day. The first is in the positive evidence presented by him that not only has the industry recovered from the disastrous falling-off in sendout during the depressed times of 1893–4, but that it actually, in 1895, went on to greater volume than any ever before attained. It is true that Mr. Lamson's statement is mainly based on the returns from the advance sheets of the Massachusetts Board of Gas and Electric Light Commissioners—which returns this year by-the-way, have been tabulated with commendable, in fact, remarkable celerity—rather than from his own inquiry; still what better basis for estimating the real condition of the trade could be taken? And, certainly, it is quite in keeping with reason to conclude that, as is the advance in Massachusetts, so also is the advance in other States. On our own account we can positively state that the gain in sendout keeps fair pace in every section of the country, for our returns for the last half of 1895, compared with those for the corresponding half of '94 (71 test points have so far answered) show a gain equal to 10.53 per cent. The second point in the address that looks handsomely prominent is Mr. Lamson's thoroughly accurate and practical placing of the honest interest of gas men in fathoming the calcic carbide puzzle. Gas makers are not prejudiced over it, and their greatest interest is to know whether they can avail themselves of its aid as an enricher, or even otherwise. It is all a question of its worth in use, which must naturally be determined by its worth in money. And right here let us say that we are and have been thoughtfully studying "it from every standpoint," and at the present time we know of no reason that would cause us to alter our belief in Mr. Bredel's figures printed by us months ago, showing the cost of a net ton of calcic carbide produced by electrolytic action to be not one cent less than $40. The address as a whole is a remarkably interesting compilation. Mr. Hinman's paper on "Photometry," which, with the discussion on it as well, appears in our current instalment of the proceedings, is a plain, well-put article; and we are glad to hold with him that the standard candle is not half so black a devil as it is usually painted. The paper and the discussion will often be referred to later on as references well worth studying.

THE THIRD ANNUAL MEETING OF THE MICHIGAN GAS ASSOCIATION.—Our advices respecting the meeting of the Michigan Association, held at the Hibbard House, Jackson, February 19, go to show that the sessions were successful in point of attendance and interest. Out of the 37 Companies in the State, no less than 30 had representation at the meeting. President H. D. Walbridge and Secretary H. H. Hyde conducted the proceedings in businesslike fashion, Mr. Walbridge's address, as "Western Observer" writes, being well worthy of wide circulation. The papers brought out lively discussions, and the social side of the convention was most enjoyable. The officers elected were: President, Mr. W. M. Eaton, Jackson; Vice-President, Mr. W. H. Douglass, Ann Arbor; Secretary and Treasurer, Mr. H. H. Hyde, East Saginaw. The next meeting place is Ann Arbor.

NOTES.—We regret to report the shockingly sudden death of Mr. Wilbur H. Townsend, the well-known oil broker, who succumbed to an attack of heart disease, on the morning of last Wednesday, while on his way to his office. He was in his 49th year.——Mr. Adam Weber has been awarded the contract for supplying the Consolidated Gas Company, of this city, with all the retorts, blocks and tiles required by it during the ensuing year. The Montreal (Can.) Gas Company has also awarded to Mr. Weber a contract for the erection of a stack of 12 benches of 7's. All this material will be got out at Mr. Weber's new plant at Weber, N. J.

[OFFICIAL REPORT.—REVISED BY THE SECRETARY.]

TWENTY-SIXTH ANNUAL MEETING OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

HELD AT YOUNG'S HOTEL, BOSTON, MASS., Feb. 20 and 21, 1896.

FIRST DAY—MORNING SESSION.

The Twenty-Sixth Annual Meeting of the New England Association of Gas Engineers was held at Young's Hotel, Boston, beginning Thursday, the 20th February. The President (Mr. Chas. D. Lamson) called the Association to order at 10 A.M., and the Secretary (Mr. Chas. F. Prichard) recorded.

INTRODUCTORY REMARKS BY THE PRESIDENT.

The President—This is the time at which we should call the meeting to order. I have myself recognized, and others have spoken to me of the large number of people who are outside this hall, who are friends of ours, but who are not members of the Association; and I suggest that they be invited to take seats with us. I will ask Mr. Slater to invite such friends to come in. The first business is the calling of the roll of members.

ROLL CALL.

The Secretary called the roll, and the following members were found to be in attendance:

Honorary Members.

White, Capt. W. H., New York City.

Active Members.

Addicks, W. R., Boston, Mass.	Long, R. J., West Point, N. Y.
Africa, W. G., Manchester, N. H.	Macmun, G. F., Marlboro, Mass.
Allyn, H. A., Cambridge, Mass.	Manchester, G. L., Easthampton, Mass.
Anderson, W., East Boston, Mass.	
Atwood, H. A., Plymouth, Mass.	McKay, W. E., Boston, Mass.
Bartlett, L., Cottage City, Mass.	Neal, G. B., Charlestown, Mass.
Bush, R. W., Brooklyn, N. Y.	Nettleton, C. H., Birmingham, Conn.
Clark, W., Philadelphia, Pa.	
Coffin, J. A., Gloucester, Mass.	Norton, F. W., Nashua, N. H.
Coffin, I. C., Providence, R. I.	Norton, H. A., Boston, Mass.
Coggshall, H. F., Fitchburg, Mass.	Norton, W. F., Nashua, N. H.
Cooper, A. F., Exeter, N. H.	Nute, J. E., Fall River, Mass.
Coyle, P., Charlestown, Mass.	Nutting, C. H., Chicopee, Mass.
Crafts, D. W., Northampton, Mass.	Page, F. D., Fitchburg, Mass.
Davis, A. E., Ware, Mass.	Parker, A. H., Bangor, Me.
Davis, F. R., Athol, Mass.	Parker, F. H., Burlington, Vt.
Dye, N. C., Rutland, Vt.	Prichard, C. F., Lynn, Mass.
Fowler, S. J., Springfield, Mass.	Purinton, A. J., Stamford, Conn.
Frost, C. T., Quincy, Mass.	Shelton, F. H., Philadelphia, Pa.
Gifford, N. W., New Bedford, Mass.	Sherman, F. C., New Haven, Conn.
Gould, F. A. Brookline, Mass.	Sherman, C. D., Meriden, Conn.
Graf, C. H., Lawrence, Mass.	Slater, A. B., Providence, R. I.
Harbison, J. P., Hartford, Conn.	Slater, A. B., Jr., Providence, R. I.
Hayden, W. H., Bath, Me.	Snow, W. H., Holyoke, Mass.
Hassett, E. J., Beverly, Mass.	Spaulding, C. F., Waltham Mass.
Hintze, T. H., Chelsea, Mass.	Spaulding, G. S., Wakefield, Mass.
Hill, J. M., Concord, N. H.	Spaulding, W. H., Clinton, Mass.
Humphreys, C. J. R., Lawrence, Mass.	Stratton, W. K., Haverhill, Mass.
	Taber, R. B., Boston, Mass.
Jenks, Z. M., Woonsocket, R. I.	Tarbell, A. W., Waltham, Mass.
Jennings, F. W., S. Framingham, Mass.	Thayer, W. F., Westfield, Mass.
	Tilton, D. D., Newburyport, Mass.
Knapp, C. S., Marblehead, Mass.	Todd, J. R., Dedham, Mass.
Lamson, C. D., Worcester, Mass.	Wetherbee, G. E., Worcester, Mass.
Lane, F. H., Wallingford, Conn.	Willard, A. R., Greenfield, Mass.
Lane, H. M., Leominster, Mass.	Wood, W. A., Boston, Mass.
Leach, H. B., Taunton, Mass.	Woodward, R., New Rochelle, N. Y.
Learned, E. C., New Britain, Conn.	

Associate Members.

Allen, W. S., Boston, Mass.	Mace, F. W., Lynn, Mass.
Brown, F. H., Waltham, Mass.	Mason, V. W., Malden, Mass.
Brown, A. P., Boston, Mass.	Pratt, F. S., Boston, Mass.
Coburn, C. M., Chelsea, Mass.	Sprague, P. W., Boston, Mass.
Cortis, D. T., Boston, Mass.	Thomas, F. W., Boston, Mass.
Davis, F. J., Waltham, Mass.	Tobey, F., Jr., Rondout, N. Y.
Hicks, G. C., Boston, Mass.	Twitchell, F. H., Bath, Me.
Hinman, C. W., Boston, Mass.	Tufts, J. P., Boston, Mass.
Holmes, R. E., Winsted, Conn.	Waldo, J. A., Boston, Mass.
McKenney, W. A., Boston, Mass.	

On motion of Mr. Sherman, the reading of the minutes of the previous meeting was dispensed with.

The Secretary read applications for membership from those whose names are given below. On motion of Mr. Sherman, the Secretary was authorized to cast the ballot of the Association for their election. Mr. Slater, who was appointed teller to receive the ballot, reported the unanimous election of the applicants, and they were declared to be duly elected to Active and Associate membership, and introduced to the Association.

NEW MEMBERS ELECTED.

Active.

Burritt, D. F., Rockville, Conn.
Cowperthwait, G. E., Danbury, Conn.
Dickens, J., Newburyport, Mass.
Hurlburt, S., Norwich, Conn.
Mansfield, G. W., Salem, Mass.
Morrison, H. K., Concord, Mass.

Associate.

Alden, G. A., Watertown, Mass.
Burrage, A. C., Boston, Mass.
Cook, R. W., Woonsocket, R. I.
Todd, R., Walnut Hill, Mass.
Wardwell, W. R., Boston, Mass.

The Secretary—There is also an application, made by Mr. H. A. Norton, the New England Manager of the Maryland Meter and Manufacturing Company, for a transfer from active to associate membership.

Mr. Nettleton—I would like to move that the application be declined. We cannot afford to lose our active members, and particularly such a one. (Applause.)

Mr. Allyn—I second that motion.

The President—It has been moved and seconded that the request of Mr. Norton for transfer from active to associate membership be declined. (Adopted.)

The President then read the following

INAUGURAL ADDRESS.

Gentlemen of the New England Association: We again extend to you a hearty welcome to the city of Boston. It seems hardly more than a few weeks since we were gathered in this place to celebrate the 25th anniversary of the formation of the Association, yet since that time another year has passed, with its varying vicissitudes, its gains, its losses, its perplexities, its successes, its ceaseless struggles with old and new problems; and now, at the close of the 26th year, I am happy to be able to record that almost universally throughout New England general business, during the past fall and winter, has been slowly but steadily assuming its normal shape. Consequently the business of supplying light, of making and distributing gas—a business which is so closely in touch with otherbusiness—has largely resumed its normal output. In most cases the daily consumption is at least equal to 1893, while in many the output is larger than in any previous year.

I regret that I am called upon to record the deaths of two of our members during the past year: Mr. William Tarbell, Waltham, Mass., who died Feb. 15, 1895, and Mr. James A. Hadley, Meriden, Conn., who died Oct. 21st, 1895. I have appointed committees to draw up suitable resolutions on these deaths, and they will be presented to you later in the session.

The advance sheets of the Gas Commissioners' report show an unusually large increase in the receipts from gas sold by meter. The report says: "The increase in 1895 is the largest of any year since the returns have been made, and is due to an unusual percentage of increase in the output of most of the Companies." Receipts for sales to public lamps show a decrease.

The price for gas has been lowered in 14 cities in the State. The average price is lower than in any previous year. The records show that the average price was, in 1886, $1.72; 1887, $1.66; 1888, $1.56; 1889, $1.45; 1890, $1.39; 1891, $1.31; 1892, $1.38; 1893, $1.27; 1894, $1.26; 1895, $1.23.

There has been a good increase in the number of consumers, and also of meters set. The increase in the total number of street mains laid has been satisfactory, but not as large as in some previous years, as would naturally be expected. The candle power of the gas generally is well up to the average of past years.

The record of the past year, as judged by this report, seems to be very satisfactory; but what I wish especially to call your attention to here is the statement, as made above, of the large increase in the send-out.

The decrease in the consumption of gas during the two years of business depression through which we have just passed resulted in the enforced idleness of very many of the concerns who manufacture apparatus, supplies and materials for gas companies. Prices for labor, materials and supplies dropped to an exceptionally low point; probably never before could repairs and extensions be carried forward at such moderate expense. Some few companies have availed themselves of these conditions, and have made substantial improvements at their works; unfortunately, the number who have acted in this way are few. Most generally, companies, finding their business materially decreasing, have lessened all expenses, preferring to run as economically as possible until the future conditions of the business should be more fully developed.

Without undertaking to criticise such action on the part of the managers of such companies, allow me to suggest a word of advice at the present time. The rapid rise of the consumption of gas to its normal rate with companies generally, and in many cases much beyond such rate, would seem to indicate that the demand for gas this year is likely to be large—it may be very large, for many people believe that we are entering on a period of very active business life, as the reverse of that depressed period through which we have just passed. Consider, then, if it is not well to prepare for such a demand. You cannot buy apparatus or employ labor at such low rates as you could a year ago, but you can get work done for much lower figures than are likely to prevail in the near future. The coming fall, when many companies will find their works in need of enlargement and improvement, is likely, if the present indications are correct, to find the manufacturers of apparatus busy with orders.

Continuing this subject, I might say a word to the directors of gas companies, as I know there are many of them who are interested in this Association. Your engineer or superintendent most generally understands the capacity and needs of your plant—the weak and strong points of your works; listen to him. A most excellent plan is to have him make carefully written reports on these points to the directors, say every six months.

Almost universally the engineers and superintendents are careful, thoughtful men. The very nature of their business makes them so. The careful and constant watch of the works and of the distributing system, the supply and demand for gas (which they cannot avoid) makes their opinion of the capacity and needs of the works under their charge of great value. Some superintendents, without doubt, may be extravagant, and, not understanding the questions of finance and the general management of the business, might wish for more than it is wise to grant; still their counsel and advise are generally most excellent and well worth having. Therefore, I say, have written reports from them, and when you have such reports listen to them.

A Word to Superintendents.—I hope it will be understood that I give this advice in the simplest manner, and take it to myself as well as give it.

Look well into all details in regard to your manufacture; no subject is too trivial or insignificant for your attention; always have at least one branch of your manufacture under consideration—I know that you usually have many; consider if in any way you can improve upon any detail, or lessen the expense in any direction. The best engineers are the very busy ones, and these men who are so very busy, and who carry such a large burden of work, you will find, if you know them, are always carrying on investigations in regard to some special details, or making a special study of some particular subject, in some way connected with their business.

Strive at all times to improve the general condition and efficiency of the works under your charge. We all know that a very great change has taken place in regard to the general cleanliness of gas works in the last 10 years. If you see that any part of your apparatus is out of order, make the needed repairs as soon as your convenience and means will allow. If your apparatus is defective or insufficient in any part, study the subject thoroughly, and then make a careful statement to your directors in writing; give your suggestions and reasons for same intelligently and concisely. You will then have fulfilled your duty and you cannot properly fulfill it in any other way.

Do not imagine that your directors do not appreciate you and so allow a feeling of discontent to grow in your minds. A moment's consideration of the subject and we shall appreciate the position of the average director of a gas company. First, he is elected a director because he owns some stock, is a business man of ability and standing; in fact, is a man of affairs, and his opinion and counsel as to the general method of conducting the business should be good. His interest is often small, and his responsibility, if he thinks of it at all, is shared by him with half a dozen fellow members; while he holds his stock he is interested; if he sells, his interest ceases. How can he feel that deep interest in the plant that you have, because you have grown up with it, put your energies into it, and are earning your living by it, and your reputation depends upon the success you make of it.

The director wishes the company to be a financial success, to be on a firm financial basis, to pay good dividends. He does not like to think that things will wear out and need repairs; it is hard enough for him to acknowledge that money must be spent to enlarge sufficiently to keep up with the growing business. This is often set down by managers to closeness or indifference, when, in fact, it is nothing of the kind, but simply that the merits of the case are not clearly understood. Therefore, I say, make careful, concise reports, and without doubt they will have their effect.

How common the saying in the earlier days, "The money of a gas

company is made in the retort house." This statement has been made time and time again by engineers in their discussions at various meetings. Without doubt much real good has come of it. The saying has become a "bye-word" among engineers and superintendents; and as a result the retort house and the generator house have been thoughtfully and carefully studied and experimented upon in every detail both large and small. Theory and practice have been brought into play and the materials for gas manufacture have been as carefully analyzed and studied. The question of labor has come to be considered, and applied intelligently. The effect is shown in many works in the the modern retort houses and generator houses, and in the results in quality and quantity of gas produced, as well as the economical results showing cost per 1,000 cubic feet of gas manufactured. We have, in fact, arrived at a point when we can tell very closely what the cost of this part of gas manufacture should be, the cost of materials being taken into account. But under the existing conditions of to-day the gas manager must not think his money is made in the retort house, and give his time to that department and that alone; he must improve his results in all parts of his works. He may have to economize in all departments.

The attention of the modern gas engineer must be turned to the important advantages to be obtained from liberal holder room and to large main distributing pipes to act as feeders into the central parts of his district. He must watch his leakage account and constantly test and repair the pipes in his distributing system. He must study the advantages of larger services and of the frequent testing of consumers' meters. Next, the manager must realize that he can make money by increasing his send-out; certain fixed charges will be less in the cost per thousand as the output increases.

To increase this output he must first endeavor to create a good feeling among his consumers towards his company. He must make his offices pleasant; he must see that his clerks are polite and attentive; he must look after the wants of his customers, the same as a successful merchant looks after the interests of the patrons of his store. He must educate the people in the use of gas stoves; an attractive exhibition and polite and careful attention to inquiries go a great way in this department. Goods should be sold to customers (if sold by the company) at a price sufficient to cover expenses; the real profit will come from the increased sales of gas.

It is very true that much of the success in the business of a gas company depends upon the construction and condition of the generating apparatus and the way in which it is worked, and I should not wish to see any less attention given to this part of the business. But I think if we should all put the same energy into other departments, giving our attention carefully to details, and establish a friendly competition as to results, as has been done in regard to the work of retort and generator houses, bringing these results to our meetings and discussing them more generally, much good will come of it. We would all be benefited.

A circular from the American Gas Light Association has just been issued, carrying out the suggestion of the last President in regard to Committees on Education and Research. I hope this good work will have the hearty support of the members of the New England Association. It would be easy to name a dozen men from our membership who are well fitted to compete for the prizes of the Committee of Research.

In regard to the other work, consider well if you have not in your employ one or more young men whom it would be well to have enter the "practical class."

I should be glad to hear, at the next meeting of the American Association, that New England had responded heartily to this most excellent plan.

Gas for Fuel.—The use of gas for fuel (heating and cooking) steadily increases. While there has been some complaint among some of the manufacturers of stoves that their sales have not been as large as they expected during the past year, still other manufacturers are unable to fill all orders; and we managers of gas companies find that the number of stoves in use rapidly increases, and the percentage of gas used for these purposes grows continually larger. The gas cooking stove is now universally acknowledged to be a success. It is convenient, it is cleanly, it is economical. It is fast driving out the coal range, and it seems more than probable that in the not distant future most of the domestic cooking will be done with gas. Heating of separate rooms is most satisfactorily and economically accomplished—just at present the gas radiator seems to be very popular, although there are many other forms which are efficient and economical, while gas logs are more and more used where cheerfulness and decorative effects are desired. Heating houses with steam or hot water, the boiler for the purpose being heated by the use of a gas furnace is now successfully accomplished. The cost for gas is somewhat more than the cost for coal to do the same work; but when we take into consideration the cost of kindling, care, ashes, the evenness of the heat in the house, the great convenience of handling with almost no labor, the gas furnace is sure to come into use in houses where luxuries are appreciated and willingly paid for.

Welsbach Light.—These incandescent gas lamps have been more successful than ever during the past year, and they seem to be giving universal satisfaction; probably in no other way can an equal amount of light be obtained for the same expenditure of money as can be obtained with the Welsbach or some similar incandescent gas lamp. In many cities and towns these lights have displaced a large percentage of the incandescent electric lights, and they have also superseded many of the patent arrangements for lighting with oil.

Many of the gentlemen present enjoyed the hospitality of the Welsbach Light Company, in Philadelphia, in October, and so had the opportunity of visiting the manufacturing plant of that Company in Gloucester City. The visit was extremely interesting and instructive; while there, we were told that the Company is now equipped to produce 10,000,000 mantles per year. This gives us an idea of the spread of the use of these efficient burners. I am glad to say that we are to have a descriptive paper on the "Welsbach Light" read at this session, and have no doubt that this paper will be of great interest to us all, but more especially to those who were not so fortunate as to be present at the meeting in Philadelphia.

About January 1st the Welsbach Company put on the market a new form of burner with an electrical lighting attachment. The burner can be lighted without the use of a match. There is no explosion in lighting. This will be a very great convenience, and it would also seem that there should be a material decrease in the expense of mantles and chimneys.

Oil and Naphtha.—Crude oil and the various products distilled therefrom have come to play such an important part in the manufacture of illuminating gas, since higher candle power has been required, and more especially since the introduction of water gas, that any change in the oil market is of vital importance to the gas manufacturer.

During the past few years, up to the spring of 1895, most companies were using naphtha for the manufacture of water gas. In March and April of that year the oil companies began to advance the price of naphtha very rapidly, and it soon became evident that there was a scarcity of naphtha in stock. As the price of oil advanced there was great excitement in the market. The oil people recommended to such companies as had suitable apparatus the use of a product called "gas oil" in the manufacture of their water gas. After some experimenting by engineers this grade of oil was quite generally adopted, although in some forms of water gas apparatus only naphtha can be used. "Gas oil" is sold for about two thirds the price of naphtha.

There seems to be a growing scarcity of petroleum, and unless new fields are soon discovered the price of manufacturing in this department will be very materially increased. Companies that must have naphtha for their manufacture are annoyed and much disturbed.

There is also more or less talk among the gas manufacturers in regard to the varying quality of the gas oil furnished by the oil companies. It is unfortunate that we gas engineers, as a rule, know comparatively little on this subject. As regards coal, we are well informed by the many careful analyses that are made of all the coals put on the market, and many gas engineers are capable of making these analyses for themselves; but in the case of oils it is different. There may be a variation in every car of oil received, and at the present time there are few, if any of us, who can carry on tests which will demonstrate the real value of the oil we use for the purpose for which it has been purchased.

It is to be hoped that some of our members will study upon this important subject, and that we shall hear from them at an early date.

Coal.—The scarcity of naphtha and the excitement in the oil market tending toward a general advance in prices, have naturally resulted in an increased amount of coal gas being sent out by the companies during the fall and winter months. Companies that are equipped to do so have increased their percentage of coal gas, and companies generally that have coal gas apparatus at their works are repairing and extending it. This increase in the percentage of coal gas, together with the general increase of business, has led to a largely increased demand for coal, and such increase in the manufacture of coal gas, together with some other circumstances, resulted in one of our periodical troubles—a shortage of coal. Fortunately, the trouble was not really serious and was of short duration.

A grand scheme of organization has been recently formed in the hard

coal interests, to limit the output of the mines and so control the supply and raise prices. Another organization is being formed for the same purpose with regard to the soft or semi-bituminous coals. There is also a rumor that the same plan is to be attempted with the gas coal production, which, of course, means an effort to increase prices to gas companies.

Naphthaline.—Naphthaline has been a source of trouble and anxiety to the gas engineers for many years. Many men have talked about it, chemists have experimented with it, books have been written about it, and the engineers and superintendents have struggled with it. Still there is very little more known about it than there was 20 years ago. Naphthaline is often referred to as "that old chestnut."

In the fall of 1894 the trouble from services stopped with naphthaline was more serious all over the country than ever before. During the corresponding period of 1895 the trouble was nearly if not quite as bad. And yet we have no satisfactory explanation for the cause of the trouble, and no efficient remedy is suggested for its prevention.

Gentlemen of the New England Association, do you mean to allow it to be said that you are unable to crack this "old chestnut?" You have now a goodly number of well-educated young men in your list of membership; cannot some of them attack this nut and crack it?

While this is properly an association of engineers and managers, and the questions properly before us should be those of engineering and general business management, yet under the peculiar conditions of to-day I cannot refrain from saying a word on the situation.

Municipal Control.—In New England there seems to be more agitation in city and town governments, looking towards municipal lighting plants (more especially electric lighting plants) than ever before. Efforts are being made by interested parties to have new laws made, or old laws amended, by State Legislatures, making the acquirement of gas and electric plants by municipalities more easy; or, what is still more unjust, allowing municipalities to establish independent plants, and also do a commercial business.

Without going into a discussion of the question of municipal control, I think I may say that the laws regulating the acquirement of existing gas and electric plants by cities or towns are at present (at least in Massachusetts) just and fair, and we should use our influence to see that new legislation does not affect them to the prejudice of the interest of the gas companies.

There can be no doubt that the business of furnishing gas can be better and more economically done by a private corporation than by any city or town. All fairly conducted investigations confirm this; and we engineers who have studied the question from all points know it.

There are a number of bills of importance which must be looked after, but most of them sink into comparative insignificance when we consider the bill just introduced into the Massachusetts Legislature in the interests apparently of the Dominion Coal Company.

We live in an age of wonders and surprises, for hardly a month passes without some new and startling discovery or improvement in the scientific world; and it is much the same in the gas world. Most certainly it is the unexpected that happens.

One surprise, or startling theory, or elaborate scheme follows another. The "discovery of Willson" resulted in the production of calcium carbide in sufficient quantities to enable each gas man to obtain a lump with which to astonish himself and his friends in the beautiful laboratory experiment of producing acetylene gas therefrom, with its wonderful brilliancy. The public are startled with the proposition of the simple, perfectly safe and inexpensive plan of having cylinders of the gas in every cellar; gas to be of 240 candle power, and to cost but a small percentage of the "exorbitant" price now charged by gas companies.

This ominous cloud in our sky had barely drifted to one side sufficiently to allow a ray of hope to shine in upon us, when another cloud looms up over Beacon Hill. This certainly is a threatening one, because this time the gas companies are doomed. Those of you who have read the bill lately presented to the Massachusetts Legislature by Mr. H. M. Whitney, of Brookline, must have been convinced that there is no avenue of escape left open to us. This time the gas is to be cheaper even than acetylene. As to the candle power (if there is any at all), this bill especially provides, by a separate article, that the new company shall not be asked about it or be in any way responsible for it; but consumers will get it at a price next to nothing, and will be allowed to use Welsbach burners to get illumination from it. This bill would serve most admirably as an illustration to the story of the man who wanted the whole earth.

We have scarcely had time to consider the audacious petition of Mr. Whitney—for great favors and no restrictions—when a second bill, more incomprehensible even than the Whitney bill, but similar in general construction, is presented to the Legislature. It is called the "Lawson bill," and petitions for all the rights and privileges asked for by Whitney, but offers the State $1,000,000 for the favor. He, too, wants the whole earth; but he is willing to help turn it. Mr. Lawson, in commenting on his own bill to a *Press* reporter, remarked, "We live in a rapid age." Most assuredly we do. Following in quick succession comes the extraordinary bill of Mr. John M. Baily, and Mr. James H. Mellen follows with a bill of proposed investigation of acetylene by the Gas Commission.

Now, what is the proper position for the gas companies of the State, who are doing a legitimate and honest business, under charters granted to them by the Massachusetts Legislature, governed by laws which have been carefully made and amended again and again to bring them to their present state of perfection? Regulated as they are to-day by a Gas Commission, who have extraordinary power over all the lighting companies doing business in the State, what, I ask, is the proper attitude for these companies to take, when schemes like those of Whitney, Lawson, Bailey and others are presented to the General Court, asking for unlimited privileges, and exemption from taxation and control by existing laws?

With such a condition of affairs confronting us, it would seem wise that the lighting companies of the State should make an earnest and dignified protest against the granting of all such petitions.

Acetylene.—"Carbide of calcium" and the gas "acetylene" obtained therefrom, have furnished a fruitful subject for discussion among the gas and electrical engineers during the past six months.

Probably no one subject in the lighting business has awakened such universal interest, and led to such general investigation, since the days when Edison first solved the problem of dividing the electric current, and produced the present incandescent electric lamp. Widespread and ever-increasing interest has been felt in the development of the various incandescent gas lamps, more especially the Welsbach lamp, now so common among us; but the interest in these lamps has been largely due to the fact that they enable us to compete successfully with electricity, thus advancing the interests of our business, while acetylene is held up to us as a *menace*, if we de not acquire the right to use it at an enormous expense.

The interest in "acetylene gas" is largely due to two reasons. First, the power and beauty of the light, and the ease with which it is produced from the "carbide" making a very beautiful laboratory experiment; and, second, the widespread reports of the cheapness and effectiveness of the "wonderful discovery," as told by the parties who are forming companies in all directions to sell state, city and town rights.

It would seem from reliable information that the Electro Gas Company has lately made a material change in its prospectus. "Liquefied acetylene" is not in favor.

A very prominent feature of the original plan of doing a lighting business with acetylene gas was to place in the cellar of the house to be lighted two cylinders of "liquefied acetylene." The pressure on these cylinders would be 600 to 700 pounds to the square inch. These cylinders were to be connected to the ordinary house piping—the pressure to be reduced by a self-acting automatic valve, to the ordinary pressure under which illuminating gas is consumed.

This plan was first modified by having a mercurial safety seal that would let off any excess of pressure that might very likely occur, from various causes known and unknown. The mercurial seal acting automatically would allow a certain amount of the acetylene gas to escape into the air. This liability to sudden excessive increase of pressure in the cylinder, and the terrible nature of the explosions of mixture of air and small percentages of acetylene gas, have apparently led to the abandonment of the distribution of the illuminant in cylinders.

As proposed, the present plan for supplying cities and towns with acetylene gas is to have many small stations, each supplying a very limited district. The gas is to be generated, stored and distributed by means of the small street main pipes, in the same manner as our own gas is distributed at the present time, which plan does away with all questions of high pressure.

We are to have a carefully prepared paper on this subject, presented to us to day by one of our members, who has given much time to the study of the details of the production of carbide of calcium.

There are also quite a number of gentlemen who have given the subject careful attention. I hope, therefore, that an earnest and intelligent discussion will follow the reading of Mr. Addicks' paper. The subject is worthy our most thoughtful attention.

There is sufficient value in sight, in this discovery (a practical method

of producing " carbide ") to make the subject one of great interest, and the possibilily of our finding herein a *new enricher* at a reasonable cost leads us on in our investigations. But can it be produced at a reasonable cost? Ah! there is the *if* in the question. It is useless for me at this time to prophesy as to the future. There may be something in it for us, and if it is to be of value no one will receive it more willingly at a fair valuation than the gas companies. The only proper thing for the gas companies to do is to study the matter thoughtfully from every standpoint. In the meantime, let us not be disturbed by the loud talk and the flaming posters of the parties who are selling rights, and who proclaim aloud the old cry: "The days of the coal gas are over; the wheels of manufacturing are to stop; the great mains of the gas distributing system throughout the country are soon to be but old iron; and the 'acetylene candle' is to light up the land."

Let us keep steadily on in the line of our legitimate business, let us be progressive, but not too easily led into new ventures, until we have thoroughly tested and proved them. And it is safe to say that we shall continue to pay our debts, and our dividends, in the future, as we have in the past.

COMMITTEE ON PRESIDENT'S ADDRESS.

On motion of Mr. Neal the following gentlemen were appointed a committee to consider the President's address: Messrs. C. J. R. Humphreys, C. H. Nettleton and Samuel J. Fowler.

INTERMEDIATE PROCEEDINGS.

The Secretary read a communication from Mrs. A. Willis Tarbell, expressing her appreciation of the sympathy extended to her by members of the Association in her recent bereavement.

The Secretary read the following telegram, and was instructed to send an appropriate reply:

AUSTIN, TEX., Feb. 19, 1896.

New England Association of Gas Engineers, Young's Hotel, Boston, Mass.: The Texas Gas and Electric Light Association sends greeting and best wishes. W. E. HOLMES, President.

The President—I took the liberty of appointing the following committees to prepare suitable resolutions respecting the late Mr. William Tarbell and the late Mr. James A. Hadley, two of our members who died died during the year. On the Tarbell resolutions, Messrs. Geo. B. Neal, F. J. Davis, Charles F. Spaulding. On the Hadley resolutions, Messrs. A. B. Slater, F. C. Sherman and E. C. Learned.

MEMORIAL RESOLUTIONS.

The memorial submitted by the first-named committee is appended:

The undersigned respectfully submit the following memorial to be entered on the records of the Association:

William Tarbell was born in Mason, N. H., July 4, 1824, and died at his home in Waltham, Mass, February 15, 1895.

In 1868 he was appointed Superintendent of the Milford Gas Light Company, a position held by him until 1876, when he engaged in other business. In 1877 he accepted the office of Superintendent of the Waltham Gas Light Company, a position that he filled acceptably, until his retirement therefrom, in 1887. During the last year of his service at Waltham the Company installed an electric plant.

He joined the New England Association of Gas Engineers in the year 1874. During the past few years he has been engaged in the construction of gas plants, at the American Watch Company's factory, Waltham, at Middleboro and South Framingham, Mass., and at Laconia, N. H.

He also superintended some special work for the city of Waltham in street construction and the laying out of a new parkway.

He was united in marriage to Miss Mary A. Noyes, of Amherst, N. H., January, 1850, who survives him. His son, A. W. Tarbell, is a member of this Association.

Mr. Tarbell was quiet and unobtrusive by nature, but positive in his convictions and opinions, and ready to assert them when occasion required.

As a friend and associate he was kind, sympathizing and helpful. In the discharge of the duties and responsibilities which devolved upon him in the several positions of trust which he held during his useful life, he was industrious, conscientious and faithful. These characteristics contributed largely to the financial success of the organizations with which he was connected as Superintendent or in some other capacity.

GEO. B. NEAL,
F. J. DAVIS,
CHAS. F. SPAULDING, } Committee.

Feb. 19, 1896.

The memorial respecting Mr. Hadley was then read.

James A. Hadley, a member of this Association for more than 20 years, died at his home, in Meriden, Conn., during the night of October 21st, 1895, in the 68th year of his age.

He had been connected with the works of the Meriden Gas Light Company, as Superintendent, for 30 years, and to his wise judgment and intelligent management the success of the Company is largely due. He was of a retiring disposition, but secured the confidence and esteem of his associates and of the community in which he spent so large a portion of his active business life.

In his death the Association is deprived of the benefit of his long, practical experience, and we place upon our records this brief tribute of respect to his memory.

A. B. SLATER,
F. C. SHERMAN,
E. C. LEARNED, } Committee.

REPORT OF THE SECRETARY AND TREASURER.

Secretary Prichard read his report, as Treasurer, which was, on motion of Mr. Slater, received and placed on file. A summary of the report is:

Receipts.

Balance from last report	$140.45	
Receipts from all sources	690.00	
		$830.45

Expenditures.

J. R. Whipple & Co.	$366.80	
Galvin Bros.	15.50	
J. H. Richardson.	28.00	
T. P. Nichols	86.25	
C. F. Prichard	200.00	
Sundry small accounts	14.20	
Balance	119.70	
		$830.45
Balance in Derby Savings Bank		$576.94

Approved, J. A. COFFIN, S. J. FOWLER, Committee.

READING THE PAPERS.

The President here called upon Mr. C. W. Hinman, of Boston, to read his paper entitled

SOME NOTES ON PHOTOMETRY.

Photometry, or the measurement of light, is the art of determining how much stronger one light is than another. The only method we have of measuring light depends on the impression it makes on the eye. The eye alone cannot tell us even approximately how much stronger one light is than another. We might think, from simple inspection, that one light was one hundred times stronger than another; in reality, it might be ten times as strong, or it might be a thousand times as strong.

The only practical method of comparing two lights is by some means to bring them to an equality at the point of comparison, and then, by the various applicable natural laws, to compute the ratio that the two lights bear to each other. It follows that the accuracy of the whole determination cannot be greater than the accuracy with which the eye can determine the equality of two lights. It is then evident that to insure the greatest accuracy the comparison must be made under conditions that are the most favorable to the eye.

It has not been found practicable to make the comparison by looking directly at the two lights, for then the question of size and intensity of the luminous sources at once arises; and photometry deals directly only with the quantities of light, not with intensities.

Photometry says that two sources of illumination are equal, if one has an area of one hundred and an intensity per unit of area of one, and the other has an area of one and an intensity per unit of area of one hundred.

The most practicable method of comparison is to illuminate contiguous portions of the same surface by the lights to be compared, and then, by simple inspection, to determine when the surface is equally illuminated.

The surface at which the comparison is made should be one that disperses the light it receives from the two sources equally in all directions, either by transmission or reflection, or by a combination of the two.

It is absolutely necessary that the surface should disperse the rays of light in some manner; for if it did not the surface would not appear equally illuminated throughout its extent, but would show the exact form and extent of the lights and all their variations of intensity, and the lights might as well be compared directly. Of course it is necessary to have a standard of light, just as it is necessary to have a standard of length or a standard of weight.

A photometer, then, consists of the following parts: A standard light, a light that is to be compared with the standard, a plane surface at which the illumination from the two sources of light is equal, and means of

varying in some known manner the amount of light that reaches the surface from the lights under comparison. The following laws of light may be said to be fundamental for photometry:

The intensity of illumination on a given surface due to a given source of light is:

A—Directly proportional to the amount of light emitted by the source in the direction of the surface.

B—Inversely proportional to the square of the distance of the surface from the source.

C—Directly proportional to the size of the angle the ray of light makes with the surface.

In the photometers in most general use the amount of light reaching the surface of comparison is varied by altering the distance from the lights to the surface of comparison. Very few photometers vary the illumination on the surface of comparison by altering the angle of the ray to the surface.

The surface of comparison, usually called a disc, is a very important part of the photometer, as it should disperse the light falling in a perfectly uniform manner.

Transmission discs have been made of various materials, some of the more generally used substances being thin white paper, ground glass, opal glass, a layer of dried starch or dried milk, or a sheet of plate glass (Foucault), or a sheet of stearine or paraffine (Elster, Joly).

Reflection discs are usually white, and are frequently made of white paper. (Chollar uses white crayon.) Combined reflection and transmission discs were first introduced into photometry by Bunsen. Bunsen prepared his disc from white, unsized paper, and, by some greasy substance, rendered a portion of it translucent. The unaltered portion of the paper reflects the most of the light that falls on it, while the greasy part reflects very little and transmits most of the incident light. The Leeson disc consists of a sheet of white paper with a hole, usually star-shaped, cut in its center, this sheet being inclosed between two sheets of plain paper.

In using the Bunsen disc it is necessary that the light from one source be received on one face, and the light from the other source on the other face. The original method of using the Bunsen disc was to observe only one side at a time, and to make the transmitted light equal to the reflected. The other side was then observed in the same manner, and the average of the two readings taken as the true result. It was difficult to find a disc that would read alike on both sides where the observations were taken in this manner.

Rudorff added an inclined mirror at each side and behind the disc, so that reflections of each side of the disc could be observed at the same time. By this means reflected light can be compared with reflected light, transmitted light with transmitted light, as well as reflected light with transmitted light.

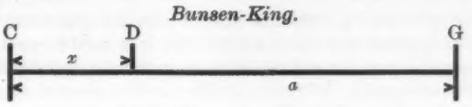
The Bunsen disc, or the Leeson modification, is employed by nearly all British, German and American photometrists. Some observers prefer the original Bunsen disc, others the Leeson modification. Personally, I never could see that one style was preferable to the other. Under favorable circumstances, and comparing lights of about the same color, the error due to setting the disc, when an average of ten readings is taken, should not be more than half of one per cent.

The relative position of the disc and the lights varies in different systems of photometry; but generally, when the comparison is made wholly by transmitted light, both the lights are on one side of the disc. When reflected light alone is used the disc may be between the lights, or they may both be on one side of the disc. With the Bunsen disc the lights are placed one on each side of the disc.

At least four different methods of varying the distances between the two lights and the disc have been used in the construction of photometers. The method usually adopted with the Bunsen disc, and originally introduced by Alfred King, is to place the two lights at a fixed distance (60, 75, 80 or 100 inches) apart, and to move the disc in the straight line connecting the two lights. Theoretically, this allows the lights to be equal, or one to exceed the other an infinite number of times. Practically, when one light exceeds the other as much as 30 times, observation becomes difficult, unless the lights are placed a long distance apart. This arrangement has the great advantage of not requiring either light to be moved during the experiment. Its disadvantage is that the illumination of the disc varies according to the power of the light tested. Thus the disc is illuminated nine times as much when two 25-candle power lights are compared, one with the other, as when a 25-candle power light is compared with a 1-candle light.

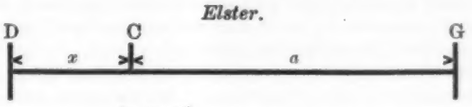
In Elster's photometer (Foucault disc) the two lights, separated by a screen, are each fixed a certain distance (24 inches) from each other, and both on the same side of the disc, which is movable. This instrument is a compact one, but cannot be used to compare two nearly equal lights.

Bunsen-King.



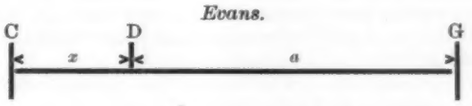
$$n = \frac{(a - x)^2}{x^2} \qquad x = \frac{a}{1 + \sqrt{n}}$$

Elster.



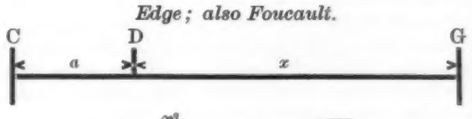
$$n = \frac{(a + x)^2}{x^2} \qquad x = \frac{a}{\sqrt{n} - 1}$$

Evans.



$$n = \frac{a^2}{x^2} \qquad x = \frac{a}{\sqrt{n}}$$

Edge; also Foucault.



$$n = \frac{x^2}{a^2} \qquad x = a\sqrt{n}$$

In the Edge photometer the disc was between the two lights. The standard light was mounted on a carriage, at a fixed distance from the disc, and both were moved to and from the light to be tested. This arrangement always gave the same illumination on the disc.

The Evans photometer has the light to be tested and the disc stationary, while the standard light is movable. The disc is between the two lights. Both the Evans and the Edge photometers have the great disadvantage of requiring the standard light to be moved. The Bunsen disc is used with both the Edge and the Evans photometers.

The Foucault, or standard French photometer, has the two lights to be compared both on the same side of the disc. The standard (a Carcel lamp) is fixed at one meter (about 3¼ feet) from the disc, and the light to be tested is movable. There is a screen between the two lights. In another form both lights are fixed, and the consumption of gas is regulated until the lights are equal.

The formulas for graduating the bars of the various photometers are as follows, the letters having the same signification in each case: C is the standard light; G is the light to be tested; D is the disc; n is the number of times the light to be tested exceeds the standard; a is the constant distance; and x the varying distance.

It is not necessary to have just a given amount of illumination on the disc. The amount of illumination given by 1 candle at the distance of 2 feet is as faint as it is advisable to employ, and the illumination given by a candle at the distance of 6 inches is stronger than is usually emyloyed. To secure the best results it is necessary to have the disc better illuminated than the photometer room. If the lowest degree of illumination for the disc is used, great care must be taken to prevent light other than that from the two sources under comparison from reaching the disc. It then becomes difficult to read the photometer scale or the notes of the determination. There is no particular disadvantage in employing a disc illuminated to the highest degree mentioned.

The most urgent need of photometry is a suitable standard of light. The light given by a candle is the standard most generally used, but there are various candles used in different countries. The English standard candle, burning at the rate of 120 grains per hour, is the standard in use in all countries speaking the English language. On the Continent of Europe several different candles are in use, and generally they are burned with a constant height of flame, instead of constant consumption.

The one great objection to the standard candle is that its light is not constant, and that it does not vary according to any known law. My experience leads me to believe that the standard candle, in the hands of an experienced observer who exercises his judgment and rejects candles that do not appear to him to be burning correctly, and who uses the

known precautions and corrections, gives a nearly constant light. The candle should be allowed to burn until there is a well-formed cup of melted spermaceti, and the end of the wick is nearly horizontal. The end of the wick should be brightly glowing, and of about the same size as the remainder of the wick. The flame should be steady and with a rounded rather than a pointed top. When a single candle is used the glowing end of the wick should be pointed to one side. When two candles are used the end of one wick should point backwards and the other forwards, the plane in which each wick is bent making an angle of 45° with the line joining the two lights.

Many lamp flames have been proposed as standards of light. Among them are the Carcel, burning colza oil; the Keates, burning sperm oil; the Hefner-Alteneck, burning amyl-acetate; various lamps by Vernon Harcourt, burning pentane; also several round-wicked lamps, burning petroleum. One of the latest is the lamp of the Dutch Commission, burning a mixture of benzol and ether. Edgerton, and also Methven, proposed, by the use of suitable screens, to use certain definite portions of an Argand gas flame as a standard.

The latest proposed standard is the pentane, recommended by an English Commission to the London Board of Trade. In this standard the flame is produced by burning a mixture of air and pentane vapor from a suitable Argand burner, provided with a screen, by which the light from the upper portion of the flame is cut off. The flame is intended to give a light equal to that from 10 standard candles. It seems to be agreed among those who have tried them that the pentane standard and the amyl acetate lamp both give lights that are more nearly constant than the flame of a standard candle. The pentane standard apparatus is somewhat cumbersome and costly. The flame of an amyl-acetate lamp contains more red rays than an ordinary gas flame does.

One very important part of gas testing apparatus is the gas burner. If the test is to be made so as to conform to the legal requirements, then, of course, the burner prescribed by law must be used. Some laws, however, do not prescribe any definite burner, but state the burner best adapted to the gas to be used, provided its use by the consumer is practicable. The Massachusetts law has this provision.

There is no one burner that is the best for all sorts of illuminating gas. It is, however, fairly safe to assume that an Argand burner will give higher candle power for the same consumption of gas than any open burner, provided the candle power of the gas is below 20 candles. If the candle power exceeds 20 I have usually found that, provided the gas contained little nitrogen or carbonic acid, the best open burner gave higher results than any Argand. Gas of almost any candle power that contains considerable nitrogen or carbonic acid I have found to give the best results when burned from a suitable Argand burner. There are many different styles of both Argand and open burners. I have found that the burners made by Sugg, of London, give as good results as any.

An Argand burner gives the same amount of light toward all points of the horizon. This is not true of the flat-flame burner, as the light given out by the flat of the flame in some cases is one-fourth greater than that given by the edge of the flame. In general the richer the gas the greater the difference in the amount of light given out in the different directions. Starting with the light emitted by the flat of the flame as a standard the light diminishes regularly, but very slowly toward the edge of the flame, until near the edge, where there is a sudden fall in the light. This raises the question as to position of a flat-flame burner in photometric testing. The correct way is to make the test with the burner in positions varying not more than 10° from each other, and then average the result. As this method requires at least ten tests, it takes too much time. If the tests are made with only the flat of the flame and the edge of the flame and the average of the two taken as the correct mean, the result will be much below the true average. If the exact angle at which the flame gave out its average candle power was known the gas might be tested at this angle. But this angle varies with the gas and burner used. My practice has been to test the flame at an angle of 45°, as this may be called an average of all the angles.

When the candle power of a gas is mentioned it is always assumed, unless the contrary is stated, that the gas was burned at the rate of 5 feet per hour; or, at least, that the observed candle power was corrected to that rate. I am of the opinion that it is a great mistake to endeavor to burn all sorts of gas at one fixed rate. In the first place this practice necessitates a great variety of styles and sizes of burners if different sorts of gas are to be tested. Again, it is not a fair mode of comparing the illuminating value of various gases, for as a general rule the greater the rate of consumption of any gas the greater its candle power per foot burned. There is no reason why consumers should want a burner to give a light equal to 15 candles with one sort of gas and to give a light equal to 30 candles when another sort of gas is supplied. A far preferable manner of comparing the illuminating values of various gases would seem to be to burn them in a suitable burner so as always to give a certain candle power, say 20 candles. The illuminating value of a gas could then be expressed by the number of feet per hour required to give the agreed on candle power. The French use this method of expressing the illuminating value of gases. It is not necessary, however, in using the proposed method of testing, to alter the ordinary custom of stating illuminating values. All that is necessary is to burn the gas so as to give a certain quantity of light and then calculate what would have been the result if 5 feet per hour had been consumed, assuming that the light produced is proportioned to the gas consumed. I think this method has actually been used by all photometric observers who have had occasion to test rich gases that could not be burned at the rate of 5 feet per hour without smoking. An English Commission has recently recommended this method of burning gas and stating the results.

In gas testing the photometer should be placed in a well ventilated room, that is not draughty, and of a cubic capacity of not less than 1,500 feet. If an open bar photometer is used this room should be painted a dead black, and provided with close fitting shutters, the photometer being in the middle of the room. With a cabinet photometer it is only necessary to cover the windows with dark curtains. The necessity for a large, well ventilated photometer room is not as well recognized as it should be, in view of the fact that the products of combustion (water and carbonic acid) vitiate the air and render it impossible for either the candle or gas to burn properly, when these products are present in any considerable quantity. If the photometer is placed in the middle of a room of 3,000 or 4,000 feet capacity, the ventilation through the walls of the room will be sufficient to keep down the heat, carbonic acid and water produced by the combustion of the gas and candles so that no unfavorable effect will be produced.

Photometers for gas testing are either open or closed and have the lights from 60 to 100 inches apart. I consider the ordinary arrangement of a fixed light at each end of the instrument and a movable Bunsen disc between the lights, as the best arrangement yet devised.

To obtain correct results in photometry it is necessary that the only light reaching the disc should be the direct light from the burners under comparison. Numerous screens should be placed between each light and the disc, so as to cut off all but direct rays. The screens should be of woolen cloth, or of some rigid substance painted a dull black; they should have their apertures brought to a sharp edge to prevent reflection. Open bar photometers are now made as well screened as closed photometers; and closed photometers are practically as well ventilated as open bar photometers. Personally I prefer a closed photometer, on account of its not requiring a closed room.

All modern candle balances are made to weigh the candle in place and while burning. The balance should be delicate enough to show $\frac{1}{10}$ of a grain with certainty and still not vibrate too slowly. From four to eight double vibrations per minute is about right. The candle may be balanced and also weighed by adding weights to the pans or by sliding weights along the beam of the balance, the beam being graduated for the weighing. The first method is the more accurate, but the last is somewhat more convenient. Some experimenters use one candle, but the majority prefer two. Perhaps two candles are more likely to give an average result, but they produce so much heat that they must be separated some distance, about 2 inches from center to center, to allow of the formation of the proper cups of melted candle.

The disc should be mounted so that it can be moved easily and smoothly, and so it can be easily reversed, as discs are liable to give different readings on the two sides.

Two styles of wet meters are in use for photometry. The older style passes $\frac{1}{10}$ of a foot of gas per revolution, and is graduated to feet, tenths, hundredths and thousandths. The newer style passes $\frac{1}{12}$ of a foot of gas per revolution and is graduated to twelfths, sixtieths and six-hundredths of a foot. With the newer style of meter there is usually combined a clock, there being only one dial, and the long hands of both clock and meter are mounted concentrically. With this last arrangement, if the gas is passing at the rate of 5 feet per hour, the two hands move together over the dial. It requires a separate timepiece for the candle. I much prefer the older form of meter with a separate minute clock or stop-watch. The newer style of combined clock and meter is somewhat liable to get out of order, requires two timepieces to be accurately adjusted to the same rate, and is an inconvenient arrangement to use if the gas is to be tested at any other rate than 5 feet per hour.

A governor is commonly used with a photometer, but seems to be not

really necessary, as the pressure of gas seldom alters considerably during the five or six minutes occupied by the test.

Two forms of micrometer cocks are in use. In one the slow motion is obtained by the use of a screw acting on a toothed wheel or lever. The objection to this form is the unavoidable back-lash. In the other style the slow motion is obtained by simply extending the arm of the cock several inches. This last style, although it is not as compact, seems preferable on account of its freedom from back-lash.

Although a pressure gauge is not necessary for testing the illuminating power of a gas, yet it is convenient, especially in burner testing. It is convenient to have it so connected that the pressure at any part of the apparatus may be tested.

The following directions give the method of procedure that I have usually followed in gas testing: Before turning the gas on to the meter, see that it is set level. Remove the plug in the drip of the meter and the plug or cap above the gauge glass, so that both inlet and outlet are open to the air, and, if necessary, alter the water in the meter so that the bottom of the meniscus in the gauge glass is just even with the scratch on the glass, and close the meter. Close the cock near the meter, turn on the gas, and by observing the meter see if there is any leak between the meter and the burner. Light the gas and candle. If the meter and clock are combined in the photometer used, start the meter clock and the timepiece used for timing the candle so that they will coincide. Observe them again in ten minutes. If they are more than two seconds apart one or both should be readjusted.

When lighting the candle it is well to melt a little of the spermaceti by holding the match near it before lighting the wick, so that the wick will not get burned up before the spermaceti melts. When extinguishing the candle, the wick should be touched with a piece of spermaceti so as to saturate it with grease and prevent its smouldering. This leaves the candle so that it soon gets into proper condition when lighted again. Place the disc holder so that the pointer indicates just 16, place a rule against one side of the disc and measure to the marks indicating the place of the candle. This distance should be just one-fifth of the distance between the lights. The glass chimney and the mirrors should be cleaned, if necessary, and any dust removed from the screens. Place the disc in about the position it will occupy during the test. By means of a small mirror placed near the center of the disc observe, first, one light and then the other, and notice if there are any noticeable reflections or any stray light that can reach the disc. If any are found they should be removed before the determination is begun. The gas should now be adjusted to the rate best suited to the burner or to the desired rate. Set the disc and note the reading, reverse the disc and read again. Repeat several times. If the readings change on reversal more than half a candle, change the disc. If the candle now seems to be burning properly, place it in position. If the balance weighs with a rider place it at zero. Move the position of the counterpoise, or change the weight in the pan of the balace until the candle end of the balance is about two grains heavier than the other.

In testing, a minute clock or a common watch with a large, clear second hand will be assumed as the timepiece, and a meter reading to thousandths as the style of meter used. At the next even minute read the meter to the nearest thousandth. Then watch the index of the candle balance and note the minute and second when the pointer is at zero. Put 10 grains in the candle pan of the balance, or change the rider an equal amount. Proceed to take readings of the disc at regular intervals of time. The disc is set properly when both sides present the same appearance. The disc should be moved each time a reading is made, first on one side of the true position and then on the other. I prefer to view the disc at a distance of about 2 feet, so that both eyes may have both sides of the disc in view at the same time. After taking half the readings reverse the disc and take the other half.

After observations have been taken for nearly five minutes, the observer should give his attention to the candle and note when the pointer to the candle balance passes the zero mark. The state of the meter is taken six minutes after it was first taken. If it is desired to take another observation, add another weight to the pan of the balance and proceed as before.

If the time of burning 10 grains of candle has varied more than 15 seconds from 5 minutes, the determination should be considered as only approximate and should be repeated.

In case a stopwatch is used instead of the minute clock or common watch, the procedure may conveniently be as follows: After the gas is regulated to the proper rate and the candle burning and balanced properly, start the watch when the candle balance pointer crosses the zero mark. Add 10 grains to the candle side of the balance. Note the state of the meter some seconds (20 or 30) later. Take regular readings of the disc until it is time to read the meter; then, just 4 minutes after the first reading of the meter, read it again and note the result. Continue to take readings of the disc until the pointer of the balance is about to cross the zero mark. When the pointer crosses stop the watch.

When one candle is used the extremes of the readings should not be more than 1½ candles apart. The temperature of the gas in the meter and also the height of the barometer should be observed. For each three-tenths of an inch that the barometer is below 30 inches, and for each 5° that the temperature exceeds 60° F., 1 per cent. should be added to the observed candle power. If the barometer exceeds 30 inches, or the temperature is below 60°, the corrections are to be subtracted from the observed candle power. The following example shows the calculations:

13 min.....	Meter, 4.372 feet.	Ther., 68° F.
19 "	" 4.863 "	Bar., 29.4 in.
6 min.....	.491 feet.	
12 "	.982 "	
	1.000 "	

1.8 per cent. to be added.

13 min. 21 sec.....	0 grains candle.
18 " 32 "	10 "
5 min. 11 sec.....	10 "

3⅔ per cent. to be subtracted.

Corrections—

\+
1.8 gas.
1.6 ther.
2.0 bar.
5.4
3.7
1.7 per cent. to be added to observed candle power.

Disc Readings.

19.4 candles.	19.7 candles.	19.9 candles.
20.3 "	20.2 "	20.4 "
20.1 "	20.0 "	19.7 "
19.5 "	19.3 "	
19.4 "	19.2 "	10.1 candles.

13) 10.1

19.78 candles (average).
.34 " correction.
20.12 corrected candle power.

If the gas had burned at the legal rate of 5 feet per hour, it would have burned 1 foot in 12 minutes. The gas was burned at the rate of 0.982 foot in 12 minutes, therefore it burned 1.8 per cent. too slow, and the observed candle power should be increased this amount.

The gas was measured at 68° F., instead of at the standard temperature of 60° F., producing the same effect as though the meter had been 1.6 per cent. fast. The candle power should, therefore, be increased by this amount.

The gas was measured under a barometric pressure of 29.4 inches, instead of under the standard pressure of 30.0 inches, and again we get the effect of measuring by too fast a meter, and the candle power should be increased 2.0 per cent.

The candle should have burned at the legal rate of 120 grains per hour, or 10 grains in 5 minutes (300 seconds). It did take 311 seconds to burn 10 grains. In other words, it burned 3⅔ per cent. slower than it should, as each 3 seconds is 1 per cent. of the whole time, and the observed candle power should be diminished by this amount. These corrections for rate of burning of both candle and gas are made on the supposition that the light produced is exactly proportional to the amount of combustible burned.

In the example just given the corrections are made by percentages, and they are added and subtracted, instead of being multiplied and divided, as they should be to be mathematically correct. If none of the corrections, including the final one, exceed 5 per cent., the method just given permits a maximum error of one-fourth of 1 per cent. In the example given the exact corrections would make the candle power 20.14 instead of 20.12. Even if the final correction is 10 per cent., and none of the others exceed 5 per cent., the resulting candle power is in error not more than 1 per cent.

None of the corrections are liable to exceed 5 per cent., except that for

rate of burning. When the rate of burning varies materially from 5 feet per hour, the correction is made by dividing the observed candle power by the number representing the amount of gas burned in 12 minutes.

In the following example the timepiece used is a stop-watch and the rate of burning the gas is much different from 5 feet per hour.

Gas	3.487 feet	min. 20 sec.	Bar., 30.1
	3.579 feet	4 min. 20 sec.	Ther., 56° F.
	.092 feet	4 min.	
	.276 feet	12 min.	

Candle ..... 4 min. 51 sec. = 10 grains.

Disc Readings.

12.1 candles.	12.5 candles.
12.3 "	12.6 "
12.2 "	12.4 "
12.4 "	12.4 "
12.1 "	12.7 "
12.0 "	
12.2 "	15)48
12.3 "	
12.3 "	12.32 candles (average).
12.3 "	

Corrections—

+	—
3.0 candle.	0.3 Bar.
	1.3 Ther.
	1.6
	3.0
	1.4 per ct. to be subtracted from observed C. P.

12.32
.17 = 1.4 correction.

12.15 = candle power to be corrected for rate of burning.
12.15 ÷ 276 = 44.0 corrected candle power.

While the photometer used with due care gives results that are fairly exact and reliable, it must not be assumed that they are to be taken as the sole criterion of the usefulness of any given light. The ordinary photometer only measures the amount of light given out by a luminous source, but does not indicate its intensity, its color or its steadiness, and all these are to be considered in estimating the utility of the light. Again, the products of combustion, the heat given off, the portability, the safety of the source of light, as well as the price, are to be considered in estimating the value of different lights.

For general purposes the more closely the color of a light resembles sunlight the more satisfactory it is; but for some special purposes different colors may be more suitable. If the amount of light emitted from a luminous source is fixed, the size of the light, and thus its intensity, is, for many purposes, a question of great importance.

The human eye is a wonderful organ and can accommodate itself to see distinctly with intensities of illumination, one of which is many thousand times greater than the other. It, however, requires a considerable time to make this accommodation, and it cannot accommodate itself at the same instant to a number of illuminations of greatly varying intensities. Everyone knows that, on going from the full glare of the midday sun into a poorly lighted room, the darkness at first seems to be intense and the person is able to see only dimly. Gradually, however, the eye accustoms itself to the degree of illumination and sees objects with a fair degree of distinctness. If the person has remained in a dim light for some time and then suddenly goes into the bright sunlight he is at first dazzled and unable to distinguish objects, except in a confused way.

If a person in an artificially-lighted room looks directly past the light at some dark colored article of furniture in a distant part of the room he will see nothing but a black surface. If he looks at this same object through an opaque tube that extends past the light he is able to discern details with distinctness.

In fact, for general purposes, it is of as great importance that the illumination should be uniform as that it should be intense.

The intensity of a source giving a certain quantity of light is not of such great importance provided it is not in the field of vision. If the source of light is in the field of vision it makes a great difference in the usefulness of the light whether it is small and intense or large and dim—the quantity of light emitted being supposed the same in both cases. The intense light dazzles the eyes, while the diffuse light does not. This explains why opal globes are in such general use for shading artificial lights, although they diminish the total quantity of light emitted about one half.

A large flame has the advantage over a small one in that it does not cast as distinct a shadow. If the opaque object casting the shadow is half-way between the light and the surface on which the shadow is cast, the distance between full illumination and full shadow will be equal to the diameter of the flame. Also to cast a true shadow the opaque object must be at least one-half the diameter of the flame. These statements explain why small lights cast sharper shadows than large ones.

I think the question of the diffusibility of different lights is usually one of the comparative size of the different luminous sources; the more diffusive light being the larger one.

It follows from the preceding that, to light any space in the most generally useful manner, the light should be as large and as well distributed as possible.

For example, 100 uniformly distributed lights of 10-candle power each cannot be replaced by one 1,000-candle power light.

It seems to me that for general purposes the usefulness of any system of lighting may well be measured by the illumination at the poorest lighted spot in the space under consideration.

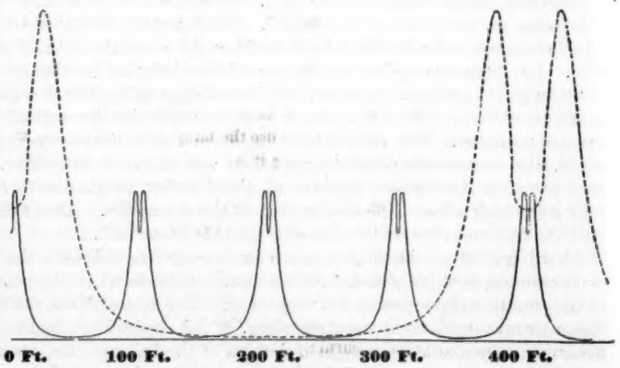
I give, in the following table, and also show graphically, the distribution of light in two systems of street lighting. In one system the lights are supposed to be of 25-candle power, 10 feet above the street, and 100 feet apart. This is the condition of a street well lighted with gas. In the other case the lights are supposed to give a light of 1,250 candles, at the angle of 45° below the horizontal, and to have the light distributed at other angles in the proportions found in the electric lamps tested at the Antwerp Exhibition, to be 30 feet above the street and to be 400 feet apart. This is about the condition of streets lighted with electric arc lamps. The surface of the street is supposed horizontal, and only the narrow strip between the lamps is considered.

The figures in the table, and the height of the curves in the diagram, give the illumination in foot-candles of the surface of the street at various points.

Illumination in Foot Candles.

Distances.	Arc.	Distances.	Arc.	Distances.	Arc.
0	.2000	10	.2234	15	.3700
20	.4523	25	.5060	30	.4620
35	.3840	40	.2943	50	.1700
60	.0990	70	.0605	80	.0376
90	.0260	100	.0186	110	.0138
120	.0103	130	.0081	140	.0065
150	.0053	160	.0045	170	.0040
180	.0036	190	.0034	200	.0033

Gas.	Distances.	Gas.	Distances.	Gas.	Distances.
.1602	0	.2284	2½	.1792	5
.1283	7½	.0887	10	.0228	20
.0097	30	.0044	40	.0038	50



Intensity of Illumination.

Electric Arc -------- Gas ———

These results show a very uneven distribution, and should, if possible, be improved upon. If there were not practical difficulties in the way the distribution of light could be rendered more nearly uniform by elevating the lights. A height of light equal to about one-fourth of the distance between the lights would be indicated by theory.

Discussion.

The President—In days gone by we often wished for a chance, or wished we did have a chance, to "talk back" at the inspector of gas. I know that I have myself wished for the opportunity; but in the case of either gas commissioner or gas inspector we have had to clench our teeth and keep our tongues still. Here is your chance. Mr. Hinman was inspector of gas in Massachusetts for twenty years; to-day he is an ordinary citizen here, and this is a good chance to talk back at him. He has given us a very valuable, interesting and practical paper. Although we are all more or less familiar with the subject, perhaps we do not understand the detail of it as well as he does, and I hope those present will enter into a very full discussion of his valuable paper.

Mr. C. J. R. Humphreys—In common with all other members I have been very much interested in Mr. Hinman's paper. There are so many points in it which might be discussed that I am inclined to think we shall have to select but a portion of them. One point that occurs to me is this: I fully agree with Mr. Hinman that, in the hands of an experienced operator, candles may be the best standard we have; but I think, as a practical question, what we want to-day is some way of getting fairly accurate and quick estimates of the value of the gas we are making, to be taken, not perhaps by experienced operators, but by some of the practical men at the works. It seems to me, as we have to cut the corners pretty close now-a-days, we should be able to know day by day just what kind of gas we are making; and that photometric tests ought not only to be made daily, but several times a day; and that what we need is some quick way of arriving at the values of the different kinds of gas, if we are making, as some of us are, coal and water gas. What I would like to ask Mr. Hinman is, whether there is to-day any practical standard that we could use in place of the candle. For straight coal gas I presume the Methven or Edgerton standard could be used; but for varying mixtures of coal and water gas we do not get satisfactory results with either. I am the more inclined to put this question, because I think several gentlemen in the room have been working on this line of late, and who have been experimenting with different kinds of oil lamps in the endeavor to find something which would give us a standard which would be fairly accurate, and which could be quickly used. I would also like to ask Mr. Hinman if he can give us the best burners to use for a water gas, say of 28 candle power. I would also like to ask him, in testing particularly such gases as we call rich gases, how much variation from five feet he thinks we are justified in allowing in our tests.

The President—I think, as Mr. Humphreys has asked several questions, Mr. Hinman had better answer them now rather than wait for the questions to accumulate. This, of course, will not deprive other gentlemen from putting questions after Mr. Hinman answers these.

Mr. Hinman—I think, as regards standards, that Mr. Humphreys has pretty well answered his own question. The candle, as every one knows who has worked with it, does not admit of very quick results. You cannot hurry it. You may get results in 15 minutes, or you may not get them for an hour—according to how the candle burns. Perhaps the next best standard that is practical is the screened light, burning straight coal gas, or some gas which is, practically, constant in composition. I think those who have used that have been pretty well satisfied with it I think, as compared with a candle, the error has been inside of one candle; and that, for the extreme variation, is rather small. I have not had a great deal of experience with screened petroleum lamps, but I am inclined to think they offer the best solution of the problem now before the fraternity. Petroleum is pretty nearly a constant thing, and it seems to me the best way to use it would be as follows: To take a certain lamp, with a certain size of screen, then standardize that lamp against a candle, and then to use the lamp so screened as a secondary standard, occasionally standardizing it with a candle. I am of the opinion that would be found a pretty satisfactory substitute. As regards testing 28 candle gas, or rich gas, I think there is no question but that the ordinary flat-flame burner of some sort is the correct one to use, both for public use and for testing purposes. The best flat-flame burner I have is a table-top burner, made by Sugg, of London. They are rather hard to procure; but in my experience I have found them to be rather ahead of the ordinary lava-tip burner. As regards the rate at which it can be burned, I do not feel any compunctions in burning it at any rate that will give 15 or 20 candle power, somewhere between those two limits, which is about all the candle power you ordinarily want in light. Ordinary gas light is somewhere between 15 and 20 candle power; the incandescent electric is supposed to be about 16 candle power. I have tested rich oil gas at less than one foot per hour, and calculated it up to five feet per hour. It is the only way you can do. It is light that you are after; no so many feet of gas.

Mr. Humphreys—Will Mr. Hinman give us the name of the Sugg burner?

Mr. Hinman—It is Sugg's table-top burner.

Mr. Humphreys—Can you state the number?

Mr. Hinman—I would not like to recommend any particular size. I find that, generally speaking, you have to experiment in order to get at the precise burner that is the standard for burning any particular gas.

Mr. Humphreys—I refer particularly to the 28 candle water gas.

Mr. Gifford—Several points occur to me with regard to this paper: One is, in quick testing, the difficulty and uncertainty of getting a correct sample of gas. I have found that when I have tried to get a sample of gas near the generator I have been bothered with tar, and with the other troubles of lack of purification. And when I have taken it from beyond the holder I have found that it has taken a great deal of time to be sure that I have had the gas burned off, which rather offsets the time required to get my candle burning. Another thing that occurred to me was the very great desirability of uniformity in taking candle power. It seems to me that if everybody would take it in the same way, we might accomplish a great deal more than if everybody takes it in a different way. I have had the same trouble with differences in candle power taken on the same days between the works and where it was tested up-town, and it has led to some argument and some difference of opinion; but I have striven to have the conditions as nearly alike as possible. I am sorry to say, however, that the result has not always been uniform. I would like to ask Mr. Hinman if he thinks that an Argand burner could not be adapted to higher specific gravity gases which would overcome the difference between the flat-flame and the Argand burner, if the difference is as great with the new Sugg's that I have heard mentioned.

Mr. Hinman—Every one knows the difficulty of getting a fair sample of gas. You have got to wait until you get the kind of gas that is in the holder or the gas main. In all cases you want to blow your gas out of your services and meters as far as the main; and if you are on the dead end of a main you ought to stop to blow out that dead end fully. Another point which I tried to bring out in the paper was the great necessity for ventilating the photometer room. I think that a great many discrepancies in photometry are due to not ventilating the photomer room properly. There m y be a difference of even one or two candles if you work in a vitiated photometer room. Curiously enough the gas seems to be the loser by it. It seems to affect the gas—the quantity of carbonic acid and water—more than it does the candle. That may not be the general experience, but it has been mine—that the gas suffered more than the candle did from the products of combustion. I have not made any definite experiments with the latest Sugg's burner by burning it on rich gases and comparing it with the open burner; but the results I have obtained with it are not so much superior to the old form as to lead me to think that you could ever use it to advantage for, say, 30 candle gas. It may be that the results of the flat-flame burner and the open burner would be equal somewhere between 20 and 25 candles; but above 25 candles I am well satisfied that the old open flame burner gives the best results.

Mr. Nettleton—I desire to ask Mr. Hinman if the practice of turning the flat-flame burner on the photometer at an angle of forty-five degrees is a general one. In the use of the photometer I have tried to find something as a standard besides candles which could be relied on, and which could be used quickly. We have been experimenting to some extent with an oil lamp, but have not got far enough to know very much about it. I would like to ask Mr. Hinman if, with an oil lamp and screen, one can rely on the candle power given by the lamp remaining constant. If you burn the lamp continuously (wishing to make tests repeatedly each day) will not the wick become charred, and will not the candle power be changed; or if you turn out the lamp at the end of each experiment will you in the course of a minute have the same candle power again?

The President—Will you describe the lamp to be used, or as you use it?

Mr. Nettleton—The lamp is of the "student" type, having a circular wick with stationary chimney, with a copper tube covering the chimney and a small opening in this tube, and burning the flame at a certain height.

The President—Can Mr. Hinman answer the question?

Mr. Hinman—I am sorry I have not had a very extended experience with this style of petroleum lamp. I am rather of the opinion that the wick would have to be trimmed each time that it was used in order to make a fair test. I hardly think it would be possible to let the lamp burn right through the day, and have it give the same light at night that it did in the morning. I think there is a certain unavoidable delay, and that with this standard you have to light it and give it proper time to get in fair burning condition. But I do not imagine that it takes any great length of time. Regarding the testing of the flat flame I think the only proper way is to make the test with the flame in all positions; taking the edge, and then every few degrees right down to the flat. But it would take nearly half a day to make a test in that manner, and none of us have time to do that. Formerly the practice with those who wished to be pretty accurate was to first test the flat of the flame, then the edge of the flame, and take the average. But that is really worse

than testing the flat of the flame, because the flat of the flame gives the maximum amount of light; then, as you incline it at an angle, the amount of light given off has fallen down very slowly. Even at 45° you may not be able to discern the difference between the light at that angle and that of the flat flame. I have done that pretty carefully, and do not think there is a difference of more than one per cent. I do not remember it it exactly, but it is very small. The light falls off slowly until near the edge of the flame, and then it falls off very suddenly. But the decrease is not uniform for all sorts of gas. Each sort of gas, as well as each burner, has a distinct curve of its own. So that you would have to know the angle of average light for each sort of gas. This angle of average light would be the proper thing to use in testing the flat flame, because that would give an average of light all around the flame. I have used 45° because, although it did not average the light, still it was an average of all the angles.

Mr. Slater, Sr.—Has Mr. Hinman had any experience with Sugg's illuminating power meter, designed for straight coal gas?

Mr. Hinman—My experience with it has not been great, but such results as I have obtained have been somewhat variable. There are several jet photometers that, with gas of about the same composition, will give very fair results—results which are good enough to work by if you standardize the instrument frequently. But when you get to oil gas or water gas, where there may be considerable variation in the nitrogen or carbonic oxide, and which will give quite a difference in the specific gravity of the gas, you are pretty much at sea; and I do not think that any of the jet photometers are of much use for anything except straight coal gas, or straight coal gas enriched with oil gas.

Mr. McKay—Referring to the corrections of candle power to which allusion was made by Mr. Hinman, I wish to suggest there is one correction not often taken into consideration—the correction for personal errors. Some three years ago, with two other men, I made a series of tests on gas, day after day for each day of two months. At the end of the first month the average by one observer was probably 25¼; the average of another was 25; the average of another observer was 24¾. At the end of the second month there was exactly the same 0.25 candle difference between the same men, thus showing a constant error on the part of two observers, and one man apparently just right. Of course in comparing the observations of one man with those of another you cannot compare the same gas, because you have burned it up, but in order to come as nearly to that as possible our photometer room is fitted with a little holder of about five cubic feet capacity, so that a sample drawn in from the main will give the different observers opportunity to make tests on practically the same gas under similar conditions. Mr. Hinman also referred to the correction of meter reading of the gas burned. It is customary in correcting for the temperature of the gas, if the gas is above 60°, to add a correction, and if it is below 60° they take something off. At the station I have charge of we test the gas for candle power from four to six times every 24 hours; and that makes a test of about every 500,000 feet made. As the result of all my experience I find the benefits obtained by having the gas heated, and the candle power given is so much greater—that is to say, gas heated above 60° gives out so much more candle power than it does at 60° or below 60°—that where you reduce it to 60° there should be a correction taken off by the candle power observer; instead of which if the gas is above 60° we are allowed to add something. If the gas is below 60° the law compels us to take something off. It is my experience with cold gas that we ought to be allowed to add something on. In order to be allowed to show this to gentlemen who have not their own opportunity to make this observation, I will speak of the fact that during the hot months of the year, when making gas in the same way, using the same enrichers, and with the condition of the works practically the same, we always get very much better results in candle power than we do in the winter months. This fact in a general way would prove that position, aside from our individual experiments.

Mr. Hinman—These results of the experience of different observers in testing candle power are very instructive; and I should be inclined to think that this difference in observers was due to the difference in their eyes; or that one or more of the observers had one of his eyes a little different from the other. Perhaps if all the observers had observed with but one eye each, the result might have been more concordant.

Mr. McKay—I will say that when this came up, in order to satisfy myself as to why this difference occurred, I, with two other men, made up a commission of three, and we examined the eyes of 200 men for what I might call aptitude at watching colors, and we found that nearly all the men whom we examined, who were color blind, were deficient in the ability to match yellow and orange woollens.

Mr. Hinman—There is another explanation. If there was any difference in the color of the gas tested, and the standard (and it is almost impossible to get two lights that are of just the same color), one man would set the disc a little different from the other. If the lights were of absolutely the same color there ought to be no difference in the sight; but if the lights are of different colors there is a chance for the personal equation to come in and modify the result. But the difference observed by Mr. McKay was very slight. I think that a quarter of a candle in 25 candles is pretty near down to the limit of error in candle power observation. I think that Mr. McKay was lucky in getting observers who could observe as close as that. As to the correction for temperature. It was supposed in my paper that the gas was invariable in composition and was about two-thirds saturated with moisture, and I followed the usual rule in allowing one per cent. for each five degrees of temperature. But that is not strictly true for dry gas. I think the correct figure for dry gas is about one per cent. for 5½°. But our gas always contains more or less moisture; and in fact I think the English tables assume that it is fully saturated. In that case there would be a variation of percentage correction for each different degree of temperature; and it would be more than one per cent. for each 5°. At the higher temperatures I think it would be as much as one per cent. in 3°. I think that the explanation for Mr. McKay's candle power being so much higher in Summer, when the temperature correction was applied, is the old familiar one—that illuminating gases always contain some vapors—in fact it is rather hard to say what is gas and what is vapor; and it is true that with all vapors cold tends to condense and heat to vaporize them. In Summer there will be more vapors, and the liquid that is condensed in Winter will be vaporized in Summer. Another explanation, perhaps, is found in the observations made by Mr. Jenkins and others, which show that the higher the temperature at which gas is burned the more favorable it is to the candle power, and the lower the temperature the less favorable. You do not get as good results, after all the corrections are made, if you burn gas at low temperature as you do at high. Heating gas adds to its luminosity, for the reason that if it is already partially warmed there is more heat available than goes into giving light.

Mr. Neal—When we see Mr. Hinman's paper in print we can better understand the force of his remarks, for then we can consult the figures which he did not read; but I must confess that every time I make a photometric observation I lose confidence in the correctness of the observation, and for two reasons, if not for others. One reason is that when the screen on the disc is placed in proper position there ought to be no shadow at all; but there is a shadow on one side or the other. The other reason is that the color of the light on one side is different from what it is on the other. We must depend greatly upon the correctness of sight; and there are sometimes, under the statute law of Massachusetts, $100 trembling in the balance.

The President—I hope that is not often the case in Charlestown.

Mr. Neal—No; the fact that it requires three consecutive observations showing a non-fulfillment of the law is evidence that a great deal depends upon the correctness of the eyes of the observer. Sometimes he has taken an observation, and then I have taken one, and, of course, as he is an officer of the State, I do not want to contradict his statement of what the candle power may be; but nevertheless we do vary. I was very glad to hear Mr. Hinman speak of the supposed 16 candle power of the incandescent electric lamp. I have tried those lamps on my photometer, just as I have tried the candle power of gas, but have never yet been able to find 16 candles in those lamps which are so marked. I have found some taken from our stock, and which have never been used, which gave as low as 9 candles. That certainly discredits the correctness of photometric observations, because these lamps were distinctly marked as having 16 candle power, when, in fact, the photometer did not show it. I wish to ask Mr. Hinman if it is possible to so make the screen or disc that the shadow will disappear altogether.

Mr. Hinman—There is, of course, quite a difficulty in making photometric observations when the color of the two lights differs. Sometimes in testing the electric arc light I have thought that the photometric observations were not of high accuracy. I have sometimes had to run the disc from one end of the bar to the other, only to find that I had arrived too late, and then one side would be yellow and the other blue. There is difficulty in balancing two lights that differ in color, and a great deal of discretion has to be used. Quite a little also depends upon getting a good disc. Once in a while you will get an ordinary Bunsen disc where the field of view is not uniform when set correctly. But, generally speaking, we are able to arrange it so that one side looks like the other, even though there is a slight difference in different portions of the disc. But with colored lights you cannot do that. Some observers have found it an advantage to use the Leeson disc. My experience is that this disc is not as sensitive, but for those observers who have had considerable difficulty with the color I think they are to be recommended. I know that some good observers prefer this disc, and it is possible that Mr. Neal could have better luck with the Leeson disc.

The President—Mr. Walton Clark has had a good deal of experience with the Leeson and other discs, and we would like to hear from him.

Mr. Clark—I do not think I can add anything to what has been said about

the Leeson disc. For me it is the best disc I have yet tried. I think that the points of the star help very much to determine the exact point. I should not want a disc in which the shadow disappeared entirely. I think a disc in which you could make the shadow disappear would not be sufficiently delicate. I do not think there would be the same delicacy about such a disc as there is about one where the shadow remains wherever the disc is placed. I think you will find the ordinary stand oil lamp, with an Edgerton chimney, is about the best standard. The slit in the chimney extends across a full diameter, and is about 3/4 of an inch wide. I have used such a standard, and it has the advantage of remaining constant for any gas and for any photometer.

The President—Does that represent one or two candles?

Mr. Clark—It would represent from five to seven candles. "Standardized," of course, against candles. It has great advantages for a man who has to test gas in different towns, or in different parts of the same town; for the standard remains the same, however much the gas may vary. This is not exactly true of the Methven or Jordan slit as used on gas. It is often important to determine the candle power of gas, not only at the works, or at a thousand yards from the works, but also at the extreme point of distribution; and in such a case the use of the oil standard has obvious advantages. I recently had occasion to make a very long series of tests, several hundred in number, of the candle power of gases, varying from 18 candles up, and I started in by using the Edgerton slit on gases, which, while not varying much in candle power, varied considerably in temperature; and I found some slight errors in the results obtained. I finally came to the use of the oil lamp, which gave constant readings. The oil lamp was tested against candles every day during the test, and we found practically no variation in the light coming in through a slot in an opaque chimney. I was sorry to hear Mr. Neal say that he doubted the accuracy of his observations. I think a great deal of mud is unnecessarily thrown at the photometer. I believe the photometer to be an instrument of extreme accuracy, and that it is, when conscientiously used, very reliable. Perhaps there is a temptation, when a hundred dollars hangs trembling in the balance, to see one light a little stronger than it actually is; but I understand that that temptation is not before the gas manager in Massachusetts, because it is not on his observation that the fine is assessed, but it depends on the observation of the State Examiner, who has no interest in it one way or the other. In the last few years a good many people have attempted to discredit the photometer, but I have still great faith in it, and I have not any very great interest in attempting to improve the standard. I think that the slotted opaque chimney on an oil lamp, when intelligently and carefully used, is as accurate as the meter which measures the gas, and more reliable than the eyes and judgment of the man who makes the observation.

Mr. Slater, Sr.—I do not propose to throw any mud, but I will relate a little incident which happened a few years ago. A friend and myself were down East, and, coming home, we stopped at a gas works. We found the Superintendent there, and my friend said, "What candle power do you make?" He replied, "About 10." How do you test it?" "By the eye." We smiled at that. But when you stop to think about it, and realize that you cannot detect the difference in a room between 16, 18, 20 or 25 candle power gas, what is the value of the test? And yet we all know the value of making scientific tests with the bar photometer.

On motion of Mr. Slater a vote of thanks was passed to Mr. Hinman for his paper.

Election of Officers.

The President—Before we adjourn it would be well to hear the report of the Committee on the Nomination of Officers.

Mr. Nettleton—Your committee, in considering the nominations, have been obliged to act under a resolution adopted by the Association some years ago to the effect that two Directors shall be retired each year. They have made up the following list of officers, which they present for your consideration:

President—Charles D. Lamson.
First Vice-President—Samuel J. Fowler.
Second Vice-President—Walter R. Addicks.
Secretary and Treasurer—Charles F. Prichard.
Directors—Frank S. Richardson, Nathaniel W. Gifford, Waldo A. Learned, Henry A. Atwood, C. J. R. Humphreys.

On motion of Mr. Slater, Sr., the ballot of the Association was cast by Mr. Sherman for the election of the nominees. Mr. McKay and Mr. Slater, acting as tellers, reported an unanimous vote, and they were declared duly elected officers of the Association for the ensuing year.

The Association then took a recess until 2.30 P.M.

(To be Continued.)

The Painting of Iron Surfaces.

Engineering Record says that a noteworthy contribution on this subject is a paper by Prof. J. Spennrath, Director of the Industrial School of Aix-la-Chapelle, and published in this year's "Proceedings of the Society for the Promotion of Industrial Arts," of Berlin. This Society had announced a prize competition on "The Investigation of the Usual Paints for Iron." While the problem has not been completely solved, and the original prize should therefore not be awarded, still the Society felt that Professor Spennrath's paper was worthy of a silver medal and a considerable money prize. The following translation[1] summarizes Professor Spennrath's experiments and conclusions.

A short preface explains the conditions under which iron rusts. The agent causing rust is a solution of oxygen in water. Oxygen without fluid water and water in which no oxygen is dissolved, are not capable of rusting iron. The oxygen of the atmospheric air, which always contains water vapor, attacks iron only when through a change of temperature the dew point is exceeded and water is precipitated. It is a mistake to believe, as is often done, that in this process carbonic acid must be present. On the other hand, carbonic acid in combination with water forms rust. Iron also rusts very rapidly if brought in contact with diluted acids or solutions of salts under simultaneous action of the oxygen of the air. The rust itself does not protect the iron from further attacks of the rust-forming bodies, because iron rust is a porous mass, not a solid covering like the oxides of other metals used in the arts, such as zinc, lead or copper. Since this mass absorbs fluid water and retains it some time, and since it has the property to condense oxygen and water vapor, we see that the formation of rust once started, the process goes on rapidly. A chemical reaction, however, of the rust itself on the iron does not take place.

The means for prevention generally used are: (1) painting with oil colors; (2) the covering with fluid or solid fats; (3) painting with tar and asphalt; (4) the rubbing in of graphite; (5) the covering with other metals; (6) the production of an oxidized surface.

The most important and most generally used means being oil paints, Prof. Spennrath has devoted his attention principally to that subject. As an oil paint we designate a thorough mixture of boiled linseed oil (the vehicle) and a finely pulverized coloring body (the pigment). There are many erroneous opinions on the *rôles* which are played by these two constituents of the mixture. It is thought that certain pigments, especially metallic oxides, form a chemical combination with the oil similar to a saponification, and that the durability of the paint depends upon this combination. Prof. Spennrath proves conclusively on the basis of numerous diversified experiments that with the usual pigments such is not the case. The drying process of oil paint takes place exclusively through a chemical change in the oil which becomes resinous by absorbing oxygen from the air. The part taken by the pigment—not considering the exterior purpose of coloring and covering—is exactly the same as that taken by the sand in mortar; as the sand facilitates the access of carbonic acid to the deeper layers of the mortar, so does the pigment allow the access of oxygen to the deeper layers of the covering. The pigment retains in the paint the same chemical quantities and is subject to the same influences as it would be if applied dry; only the latter influences cannot act so readily on account of the protective oil covering. We can therefore only talk of a reaction of the oil on the pigment in the measure that oxidizable pigments are affected by the active process of oxidation going on during drying.

After having settled this much it is a relatively simple matter to determine intelligently whether an oil paint will prove durable under given conditions. Since the destruction of the coat of paint is dependent upon a change in both its constituents, which are not chemically united, we need only ask ourselves the question what the changes are which the acting materials and forces can produce, first, on the pigment, and, secondly, on the vehicle. Among the usual pigments combinations of zinc and lead are easily changeable under certain conditions, and, therefore, to be used with caution. Zinc-white and zinc-gray are changed by smoking hydrochloric acid into chloride of zinc, after which the linseed oil is attacked. A coat of zinc-white is rapidly destroyed in the open air, because the zinc-white is changed through the action of carbonic acid and water into a crystalline carbonate of zinc, which swells to double the primitive volume; in a closed room such a coat lasts considerably longer on account of the absence of water, although carbonic acid is present. A similar increase in volume (about 33 per cent.) is experienced by red lead if by absorption of sulphureted hydrogen it is changed into sulphate of lead. White lead

1. Translated by Henry Szlapka, C.E., Trenton, N. J., from the *Deutsche Bauzeitung*, Vol. XXIX., Nos. 82 and 83.

also is destroyed by the action of sulphureted hydrogen and acids. In spite of this, Prof. Spennrath considers red and white lead, if used in a pure atmosphere, as suitable pigments. Fault has been found with them in cases where the vehicle and not the pigment was the mischievous factor. Since red lead paints are more used than any others, it is no more than natural that more bad places should be discovered in them than in others.

Pigments which are stable to a high degree, if not absolutely so, are the following:

Carbon, especially as finely-ground graphite in which it is used in the so-called Bessemer paints, as finely-ground charcoal and as lampblack; heavy spar, which, however, possesses little covering capacity; artificial and natural iron oxides. To the latter class belongs the pigment of the lately introduced "armor paint." The Professor declares the latter to be just as stable and as perishable as any other oil paint whose pigment can resist the chemical action of the atmosphere and other influences. He condemns the "senseless" statements of manufacturers who ascribe to their pigments, of which every particle is embedded in a layer of resinous oil, and, therefore, entirely separated from the surface of the iron, an electrical action upon the latter.

The Professor has thoroughly investigated, by a long series of experiments, the noxious influences which attack and destroy the hardened linseed oil. It may be remarked that the object of cooking the oil is to precipitate the slimy substances contained in it, and thus fit it for the better reception of the oxygen. Cooked oil becomes quite hard in one day, while uncooked oil requires two weeks to harden.

The experiments were made with a paint in which graphite, of all pigments the most indifferent to chemical influences, was used. They were made at first by coating thin iron plates with the various paints, and then exposing them after drying to the action whose effect was to be tested. After making such experiments for nearly a year the Professor came to the conclusion that they did not allow him to draw unimpeachable conclusions from them. We naturally gauge the effect of such actions by the amount of rust formed. But this might be caused by minute fissures in the paint which would admit the rust-forming body direct to the iron without its affecting the coat of paint itself. There are, moreover, noxious influences which affect the paint but do not form rust, while on the other hand, the bodies producing rust most abundantly do not affect the coating the most rapidly. Certain effects of the worst kind cannot be detected at all as long as the paint adheres to the iron. Such considerations led to the use of paint films, which were obtained by giving a thin sheet of zinc three carefully applied coats, allowing the paint to dry completely, and then dipping it into sulphuric acid, which rapidly dissolved the zinc but left the paint film uninjured. Twenty different experiments with such films led to the following conclusions:

1. Every paint is destroyed by diluted chloric and nitric acids, also by vapors of the same sulphuric and acetic acids. Acid vapors act more rapidly than diluted solutions of the same in water. Diluted sulphuric acid does not attack an oil paint.

2. Alkaline fluids and gases, ammonia, sulphides of ammonia and soda solutions, destroy any paint rapidly.

3. Pure water acts more strongly than solutions of common salt, salammoniac or chloride of magnesium, or natural sea water, which are feared so much as rust-producing bodies. The amount of salt in solution reduces the effect of water on the paint. The destructive action of sea water must be ascribed to the mechanical effect of the waves on the paint covering.

4. Hot water acts more rapidly than water at ordinary temperature, and may even destroy oil paint in a short time.

5. The constituents of coal ash soluble in water act destructively in consequence of their alkaline nature. For this reason the fine ashes thrown up from chimneys and settling on painted iron surfaces are to be looked on as a danger.

Several observations made during the course of these experiments led the Professor to the supposition that, all chemical actions being excluded, a high temperature might have a bad effect on oil paint. Fifteen more experiments brought him to the conclusion that increase of temperature is one of the worst enemies we have to deal with. The films used in these experiments lost their elasticity at a temperature of 203° F., became brittle, broke at a sharp bend, and shortened by several per cent. This shortening is fatal to a coat of paint on a fixed body, since the contraction induces a strain in the paint film, and gradually leads to its rupture, thus affording free access to the rain and rust. The addition of undrying mineral oils with the view of preserving the elasticity of the film has shown bad rather than good results. Paints in which the pigment is graphite are less brittle than those made of white lead or zinc; red lead is worse yet in this respect. It follows that a paint made of a specifically lighter pigment (and therefore richer in oil) resists the heat best, and this explains in a simple manner the poor showing of red lead paints.

For painted iron surfaces exposed to the air the brittleness produced by heat has the further disadvantage that the mechanical action of a strong wind carrying dust or rain and snow wears out such a film more rapidly. After becoming brittle the film cannot of course follow the expansion and contraction of the ironwork as it could in a fresh and elastic condition; the worthlessness of bending tests made before having been exposed to heat is apparent. It may be objected that such high temperatures as mentioned above do not in practice affect ironwork, but Prof. Spannrath has proven that considerably lower temperatures, acting for a longer time, produce the same evil results as the other acting for a short time only. Not only has he established this fact by experiments but he points out practical examples, of which one is the paint on the corrugated iron roof of the depot at Aix-la-Chapelle. While the lower side, which is always in shade, shows the paint in good condition, the paint on the upper side, which is exposed to the rays of the noon sun, hangs down in shreds, exhibiting the characteristic of films which had been exposed to heat and breaking off like glass. The expedient of painting iron a light color in order to reduce the heating effect has not met the difficulty, because in a short time enough dust has settled on the surfaces to make them absorb as much heat as those of a darker color.

The formation of blisters is the last noxious phenomenon investigated. Prof. Spennrath proves that this occurs when the lower coat of paint has been put on too thick, so that its inner parts remain soft yet while the outer surface has already hardened and become impervious to oxygen. This causes corrugations and folds, which are intensified if a second or even a third coat is added, thus producing additional strains between the different layers. The sun or other source of heat may finally cause portions of the paint to separate from its bed and raise blisters. This is best prevented by allowing a coat not alone to dry, but to harden before applying another coat. The first coat should not be very rich, but consist of much pigment and little oil, adding some turpentine to give the color spread. Especially good for this end in view are the specifically heavy red lead paints which give a hard surface, thus explaining the extended use made of them for this purpose. On the other hand, it is absurd to give the iron a preparatory coat of pure linseed oil, because this never gives a hard surface even after drying.

Compared with his thorough investigation of oil colors the Professor's treatment of the other modes of covering iron seems meager, although here also he gives some interesting facts not generally known. As far as the coatings with fats or oil is concerned, this, of course, has only limited application, being used for the protection of finished metal surfaces before erection only. Formerly tallow was generally applied for this purpose; but it is unsuitable because it becomes rancid, and the acids liberated thereby attack the iron by saponifying it. Of late years mineral ores are used, which being dissolved in turpentine or a thin distillate of coal oil, are applied with the brush; after the evaporation of the coal oil, the fat formed a continuous very efficient covering. Tar paints are not to be recommended. It is true that a tar paint is indifferent to the chemical effects of the air or to acids and alkalies; but raw tar always contains water, wood tar acetic acid in addition, this being itself productive of rust. Purified tar is about as expensive as oil paint, against which it is at the disadvantage of being easily melted.

Asphalt paint is as resisting as tar, but is more expensive than oil paint. While used under the name of iron lacquer for smaller utensils, it is never likely to be used on large exposed surfaces, for the reason that the very thin film is liable to mechanical injuries and often scales off in cold weather. More serviceable is a covering with tar or asphalt for cast iron pipes which are dipped hot into the boiling mass. Such a covering adheres closely, is free from water, and protected in the ground from harmful changes of temperature. It is further to be considered that cast iron rusts more slowly and less readily than iron with a smaller percentage of carbon, and that the rust combines with the silicic and carbonic acid of the deeper layers of ground to a solid mass which acts itself as a protective mantle to the iron. For this reason we find that pipes which have been buried deep for even 50 years are still in good condition.

The rubbing of iron surfaces with graphite cannot be looked on as an effective preventive of rust, since a surface which is not polished cannot be evenly coated without requiring an impracticably thick covering, which would be too expensive. The two remaining methods of covering, by coating with other metals and by an oxidized surface, have little interest for the engineer.

As the result of his investigations Prof. Spennrath comes to the conclusion that oil paints are the most effective protection for iron. The pigment can always be so chosen that the destruction of the covering shall not be caused or helped by it. We cannot, however, overcome the noxious influences to which the vehicle is subject. It is necessary to carefully supervise the painting. Making the first coat of oil alone should not be allowed. The lower layers should be hard before the upper layer is applied; the latter should contain a pigment of light specific gravity and be rich in oil, in order to remain elastic as long as possible. A long continued high temperature is most to be feared on exposed iron-work. A more than usually careful inspection of all painted iron should, therefore, be made after an excessively hot summer. Cast-iron pipe which is to be buried deep needs no protective covering.

A New Recording Thermometer for Atmospheric Ranges of Temperature.

The novel and especially valuable feature of the recording thermometer herein described is that the recording portion may be located at a distance of 25 or 30 feet from the point at which the temperature is to be measured.

This makes it possible to obtain a continuous record of the outside temperature, while the recorder is located at a convenient point within doors, where it may be readily observed, and its mechanism is not exposed to the detrimental influences of inclement weather.

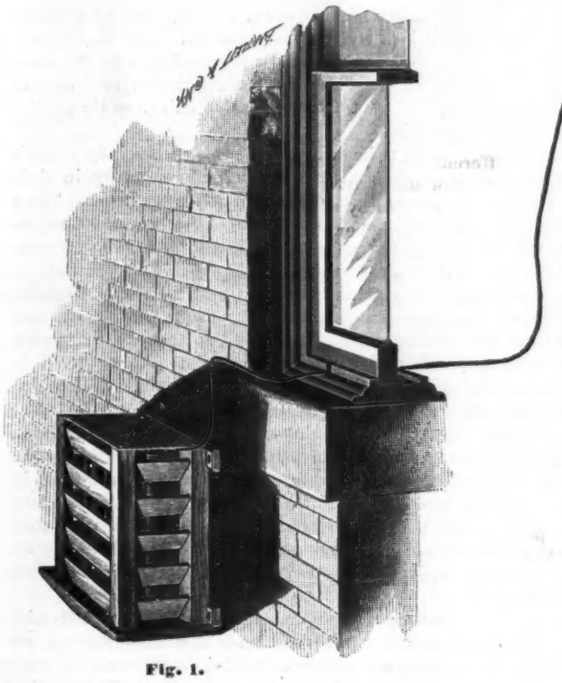


Fig. 1.

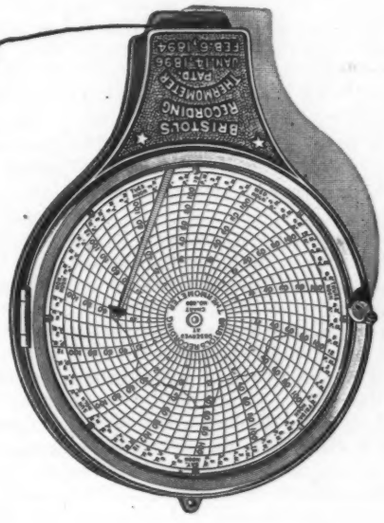


Fig. 2.

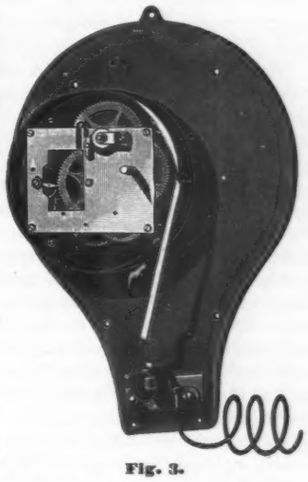


Fig. 3.

For cold storage plants, where closed rooms are to be maintained at a constant temperature, for the preservation of meats, fruits and vegetables, an instrument of this kind is of great value, as the temperature may be observed without opening the doors.

The recording part (Fig. 1) is an application of one of Bristol's recording pressure gauges. Fig. 3 shows an interior view of the recorder which consists of a pen arm directly attached to the free end of a tube of flattened cross-section bent into helical form.

The bulb portion (Fig. 2) is placed at the point where temperature is to be measured. It consists of a series of helical tubes constructed on the same principle as that in the recorder. The helical coils are suspended in a vertical position with their lower ends free, the upper ends opening into the capillary tube connecting them with the recorder.

The system of helical tubes forming the bulb portion, the pressure tube of the recorder, and the capillary connecting tube are completely filled with alcohol under pressure and permanently sealed. As temperature rises and falls where the bulb is located, there is a corresponding expansion or contraction of the alcohol, which is communicated to the recorder and registered on a 7-day chart graduated to read in degrees Fahrenheit.

Excessive pressures due to increased volume of the non-compressible liquid are provided against by the expansible form of the system of helical tubes of which the bulb is constructed.

The total volume of the bulb portion is very large as compared with that in the pressure recorder, thus avoiding the necessity of compensating for ordinary changes of temperature in the room where the recorder is located.

No correction is required for barometric changes, as only high ranges of pressure are employed.

This thermometer is being manufactured and placed on the market by The Bristol Company, of Waterbury, Conn. At 121 Liberty Street, the New York branch of the Company, one of the instruments may be seen in operation recording the outside temperature. The recorder is placed in the show window where it may observed from the side walk.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, February 10th, 1896.

Mr. Dibdin on Standards of Light.—Accidents at Gas Works.—The Gas Light and Coke Company.

An important paper[1] on "Standards of Light" was read before the Society of Arts a few days ago, by Mr. W. J. Dibdin, Chemical and Superintending Gas Examiner to the London County Council, and followed by an equally important discussion, in which Mr. Vernon Harcourt, Mr. J. Methven and others took part. These names probably represent our highest authorities on photometrical questions, and the value of the paper is not due to any special novelty, but rather consists of a plain all-round statement on the present position of this much debated question. The greater part of it was occupied by a summary and review of the conclusions arrived at by the Parliamentary Committee, whose labors have lately been brought to a close, and with which Mr. Dibdin is practically quite in accord. Various methods of using pentane as a standard were described, and a brief summary of the work recently done by the Dutch Association of Gas Managers in connection with the present subject forms the conclusion. The chief point evidenced by the discussion is that standard light is a question respecting which it has well been said that "doctors disagree." The difference in the results obtained by various operators has been the difficulty all along with the sperm candle. Not only have the usual skillful and experienced operators been employed, but cross photometers and all sorts of ingenious devices for enabling several operators to work simultaneously on one light. While researches have been extended not only to hundreds but also to thousands of experiments, with the effect of only min-

1. See JOURNAL, *ante*, p. 284.

imixing and not doing away with the evil. And the same thing applies to the pentane. Mr. Dibdin claims that his 10-candle pentane standard is, practically speaking, correct, and that copies of it can be made that will agree within a few hundredths of a candle. Mr. Methven has made an elaborate investigation of the 10-candle standard, employing half a dozen operators and extending to 500 separate tests, the result of which shows the 10-candle standard to be really equal to 10.28 candles. Mr. Methven points out that this difference of nearly 3 per cent. means an additional half candle in the case of 16-candle gas, and would be equivalent to putting an additional burden of one half-penny per 1,000 cubic feet on the London Gas Companies. In his reply Mr. Dibdin claimed the support of 12,000 experiments for his conclusions. But the results arrived at by Mr. Methven and his associates are too strong to be overcome by mere force of numbers. The conclusions of such an able authority afford proof that the pentane is not likely to give equable results under all circumstances, and therefore gas companies will do well to hesitate before accepting it as a better legal standard than the candle. The present standard is certainly not perfect, but gas companies and gas examiners are well acquainted with its vagaries and imperfections. Many of them admit of some improvement. But where is the advantage of adopting a new standard that will, under certain conditions, return a 16-candle gas as a 15½, and certainly is not likely to put an end to the battle of experts that has raged round the sperm candle for so many years. If experienced London operators differ so widely, what of the results obtained by country examiners and by gas managers who know more about earning dividends than about delicate and elaborate chemical manipulation. What is really required for general use throughout the country is a simpler standard and not a more complicated one. After reading Mr. Dibdin's paper and Mr. Methven's remarks, it is more doubtful than ever whether pentane is going to prove a real practical advance on the candle. The Dutch Gas Association, while adopting the pentane lamp, have discarded pentane and substituted for it a mixture of 9 parts benzol to 100 of sulphuric ether. The latter compound, by the way, contains about one-third of its weight of sulphur, which would escape from the flame as sulphurous or sulphuric acid. No sulphuric ether for me, thank you.

The writer has witnessed an unusual number of accidents in gas works. A remarkable one occurred at Hyde, resulting in the destruction of the governor house. This was a brick building, 15 feet square, containing three fairly large governors, 20 in., 12 in., and 10 in., respectively. Gas had leaked into a sewer, and by that means to the cellar of the governor house, where it accumulated until it was fired by the light in the jet photometer. A singular fact is that although the walls were forced outwards and the roof came down, neither of the three governors failed, and the supply of gas to the district was not interfered with. The side of a small gasholder was staved in, and the escaping gas caught fire and burnt as long as the injured plate was above water, resulting in the loss of some 20,000 cubic feet of gas. The only personal casualty was a slight injury to a woman and child who happened to be passing close by, and the whole damage does not exceed £150, so the affair is not of very great importance. But this is not the way that local journalists put it. One of them says that the explosion shook the town to its very foundations. A respectable earthquake would be a long way beyond the range of this gentleman's vocabulary.

My next item must be approached in a more serious vein, for it resulted in the death of five men, three of whom lost their lives in the brave endeavor to save the other two. If such an incident had occurred on a battlefield, the whole country would have rung with it, but heroism in a gas purifier in the course of a humdrum, peaceful occupation, does not fire the public fancy like an incident in connection with the wholesale murdering which constitutes civilized warfare. This accident occurred in a purifier forming a part of the plant for manufacturing sulphate of ammonia at the Tynemouth gas works, North Shields. There are two ordinary oxide boxes, in size 20 by 16 feet, arranged to be worked alternatively. One of them was laid off for cleaning in the usual way, and was emptied on Saturday morning, the 18th ult. On the Monday afternoon following it was to be refilled, and two men entered the box for the purpose of replacing the sieves. They immediately fell, overcome by foul gas that had accumulated in the vessel, and a scene of confusion followed, no less than eight men at one time laying senseless on the bottom of the box. The cause of the disaster then became evident, and special means for getting them out were speedily adopted, while medical and all necessary assistance was at once forthcoming. Artificial respiration was resorted to, but without success in five cases.

At the inquest, Dr. Martin gave evidence to the effect that the cause of death was poisoning by a gas, which he had reason to believe was a sulphureted hydrogen. Mr. Bernard E. Smith, the district inspector under the Alkali Acts, certified that the plant was well constructed and in good repair. With the aid of a plan he explained the nature of the operations carried on, and said that the only way in which the foul gas could have leaked into the box was through the valve. Mr. Wm. Hardie, Jr., the engineer and manager of the works, followed, and said that the whole of the operations, including the closing of the valve, were under the charge of the late foreman, Mr. Vickers, who was one of the deceased. He had been foreman for 16 years and knew his work well. Mr. Hardie's further evidence made it clear that the valve had not been closed completely, but had left a space of over 1 square inch wide open, through which foul gas had leaked from the purifier at work. Then followed the evidence by the workmen, in the course of which a man named Reay made a notable statement. He was most energetic in helping to lift the sufferers out of the box, and although he went in twice, and another man fell against him and knocked him down, he suffered no ill effects whatever. He explained that, guided by some previous experiences, he stuffed his mouth with cotton waste, as a preservative from the effects of the foul gas, and that after coming out of the box the first time, he got a fresh supply of waste. The Coroner instructed the jury that the accident was due to negligence on the part of the deceased Vickers, whose duty it was to see that the valve was closed, but it was for them to say whether the negligence was culpable. The jury returned a verdict to the effect that the deaths were caused by the valve being left slightly open, but they had no evidence to show who had turned it off on the last occasion. And they recommended that respirators should be worn by the workmen at the purifiers, as recommended in the rules for the regulation of chemical works. Also, that steps or other easy means of exit from the purifying boxes should be provided.

The principal conclusion to be drawn from this melancholy event is that waste gases from sulphate stills are much more deadly in their effects on the human system than ordinary foul or crude gas. There is a tendency amongst workmen to suppose that because the same reagents are used as in treating foul coal gas, there is not much difference between the two. But whereas the coal gas contains a very little—not more than 1 per cent.—of sulphureted hydrogen, the fumes from the sulphate boilers may contain as much as 20 to 25 per cent. One may venture to say that although sulphate plant is on a much smaller scale than coal gas purifying boxes, more fatalities have occurred in connection with it. I question whether the sulphate plant is not responsible for as many accidents as the remainder of the works. The moral is obvious. In dealing with such deadly agents as oil of vitriol, and foul gases that may comprise 25 per cent. of sulphureted hydrogen, special precautions are desirable, precautions that may not be necessary in dealing with coal gas. Workmen do not like respirators, but they might be used with advantage much more widely than they are. Many gas works men have never heard of them. With regard to the other suggestion, an easy means of exit from the purifying boxes is usually provided.

I also hear of a severe explosion and conflagration in connection with an oil gas plant at a gas works in Scotland, in consequence of too close a connection between the storage tank and the retorts. By some means or other the contents of the tank became ignited. It is said that fire travelled back through the oil feed pipe, but this is a very hazy explanation, as the oil is not supposed to ignite in the retort. It is far more likely that vapors from the volatile fluid had a concern in the matter. Two men were bruised and burned, while the retort house sustained some damage.

At the meeting of the Gas Light and Coke Co. (London), which was held on Friday last, some interesting details were disclosed. The half year ended December 31st, 1895, is in several respects a record half year. The Company has made and sold more gas, laid more mains and fixed more meters, than in any previous six months. Notwithstanding the introduction of the electric light, the public lighting account has increased more than 20 per cent. in the last 10 years. The Company is doing well with prepayment meters. They are at present expending about £10,000 per week on this item, and have 16,000 applications waiting, as the meters cannot keep pace with the demand. They find the average consumption secured by this means to be over 20,000 cubic feet per meter per annum. During the six months they have put down 3,000 ordinary and 10,000 "automatic" services, and they now number 215,000 ordinary and 29,000 "automatic" consumers, amongst whom over 100,000 gas stoves are in use. But against this there is a large loss due to the abolition of meter rents and to low prices of coke and sulphate, so that the total income is less than that for the

corresponding period of the preceding year, while the expenses have increased. Although losing on coke, they do not appear to have benefited greatly by the reduced prices of coal. Wages and salaries have increased, also the expenses in the distribution department. The prepayment system is evidently not all profit, as it necessitates a large increase in the working staff. The Company also has to pay £1,750 for the expenses of the Gas Referees and Official Auditor, which is like sending a lad to buy the cane with which he is to be thrashed at his own cost. But after all the Company has earned enough to pay its full dividends, which is the one thing needful. The Company has made 417 million cubic feet (or about 5 per cent. of their total output), of "oil gas," which probably means carbureted water gas made in generators and superheaters. There is room for a little more lucidity on this point, as there are two or three processes for the manufacture of straight oil gas by the destructive distillation of oil in externally heated retorts, at present before the public. The adoption of petroleum by this, as well as by most of the principal gas undertakings in the country, has had a marked effect on the prices of cannel. Second-rate varieties are now offered at prices but little in excess of bituminous gas coals. So here we have an instance of small gas undertakings benefiting by the action of the large ones—a contrast to the usual order of things.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. James T. Lynn, Superintendent of Distribution of the Detroit (Mich.) Gas Company, was united in marriage to Mrs. Frances L. Pelton, on Tuesday, February 18th. The ceremony was performed at St. Thomas, Ontario. Mr. and Mrs. Lynn will be "at home" after the 23d inst., at the Russell House, Detroit, Mich. Our congratulations to the happy pair; and the best of good luck to them.

At the annual meeting of the Leominster (Mass.) Gas Light Company the stockholders were well pleased over the showing made for the past year, a state that was perfectly natural when one considers that the gain in sendout for 1895, as compared with 1894, as per Treasurer Lane's report, equaled 14.02 per cent. The officers elected were: Directors, Nahum Harwood, Howard M. Lane, George F. Morse, George A. Lane, and Chas. A. Joslin; President, Nahum Harwood; Clerk, Treasurer and General Manager, H. M. Lane.

The proprietors of the Waterloo (Iowa) Gas and Electric Light Company have issued a new schedule of selling rates. Under the new agreement users of gas for illuminating will obtain their supply at the net rate of $1.60 per 1,000 cubic feet, and the rate for an illuminating and fuel supply is fixed at $1.25 per 1,000. The electric schedule is thus adjusted: All night service, residence lighting, 5 lamps, $1.75: additional lamps, up to 10, 25 cents each per month; additional lamps over 10, 15 cents each per month. Commercial and office lighting: 10 o'clock service, 50 cents per lamp per month; 12 o'clock service, 60 cents each per month. The Company agrees to furnish wiring from main line to building free, and will wire building for light at cost of doing the work, guaranteeing, however, that the charge shall not exceed 5 cents per foot. The first lamps are furnished without charge, and renewals are to be at the rate of 25 cents each.

The Fresno (Cal.) Gas and Electric Light Company has announced its intention of lowering the gas rate [April 1st] to $2 per 1,000 cubic feet

The Laclede Gas Company, of St. Louis, has just placed with the United Gas Improvement Company, of Philadelphia, its third consecutive order for water gas machinery, in the shape of a contract for its fifth set of the latter Company's well known standard double superheater apparatus. This additional equipment will go into Station A, to increase the producing plant at that point.

From the report of Mr. James Buckner, Supt. of Lamps, Boston, Mass., respecting the operations of the Lamp Department for 1895, we learn that the street lighting of the city required a total of 12,730 lamps, of which 7,592 were gas and 2,676 were naphtha lamps; 2,434 were electric arcs and 28 were incandescent electrics, of 32-candle power each. The total payments made on account of lighting, maintenance, care, etc., amounted to $552,859.11, of which electric lighting absorbed $302,234.70, the balance ($250,625.41) going to pay for gas and naphtha lighting. During the year 76 arc lamps were added to the service, as also 151 gas lamps, while the naphtha lamp service was decreased by 33 lamps. The appended table names the several Companies which supply gas to the city, the candle power of the gas furnished, the contract price paid for the same, and the net price paid by private consumers:

	Public, per 1,000 Ft.	Private, per 1,000 Ft.	Candle Power Average for Year.
Brookline Gas Light Co., for south part of city proper and part of Roxbury	$0.70	$1.00	26.7
*Brookline Gas Light Co., for Brighton	1.25	1.00	26.7
Boston Gas Light Co., for city proper	0.90	1.00	24.3
*Roxbury Gas Light Co., for part of Roxbury district	1.08	1.00	24.1
*Dorchester Gas Light Co., for Dorchester district	1.17	1.00	24.8
*South Boston Gas Light Co., for South Boston	1.17	1.00	24.8
Jamaica Plain Gas Light Co., for West Roxbury district	1.50	1.65	18.3
East Boston Gas Co., for East Boston district	1.35	1.50	17.4
Charlestown Gas and Electric Co., for Charlestown district	1.25	1.25	18.6

*The asterisks denote that the price was reduced to $1 since date of contract.

It is said that Mr. Charles N. Felton (formerly United States Senator), of San Francisco, proposes to construct a gas works at Ventura, Cal.

Some days ago the suit, brought by John H. Peake, as administrator of the estate of William A. Burgess, against the Washington (D. C.) Gas Light Company, was tried before a jury, the plaintiff being awarded the sum of $1,000. Burgess was employed by the Company in one of its engine rooms, and the explosion of a boiler scalded him so severely that he died a few days afterward from the injuries received. His administrator urged that the Company was negligent in its management of the boiler, and asked for damages in the sum of $10,000.

The plant recently installed by Mr. S. W. Vansyckel on the works of the St. Helena (Cal.) Gas Company is said to be quite up to the guarantees of its constructor.

"Western Observer" forwards the following: Mr. C. R. Faben, Jr. of Toledo, O., is around again after quite a severe bout with *la grippe*.——Before this reaches your readers probably many of them will have heard of "Jim" Lynn's marriage. A "cyclone" of good wishes will follow "Jim" and his bride, from the Western boys.

The United Gas Improvement Company has just received an order, so we are told, for the 55th set of water gas plant to be erected by it in New England. That is to say, the apparatus called for under contract lately closed with the Chicopee Manufacturing Company, of Chicopee Falls, Mass., will hold that number in the long list of water gas sets erected by the Philadelphia Company in the New England States. The plant in question will replace the present four oil gas benches that have hitherto supplied the town and mills of Chicopee Falls, and will be accompanied by new purifying boxes, exhauster and other items necessary to put the local gas works in thoroughly modern shape.

The following is the new rate schedule for an electric light service, put out on February 6th by the proprietors of the Helena (Mont.) Power and Light Company: The Helena Power and Light Company has purchased the plant and succeeds to the business of the Capital Lighting Company. Rates for lighting in effect on and after this date are as follows:

Incandescents.

10 o'clock lights,	16-candle	power	each,	per	month	$1.10
1 " "	16 "	"	"	"	"	1.60
All-night "	16 "	"	"	"	"	2.20

Meter Rates.

1,000 hours and under,	per 100	hours	90 cents.
1,000 to 2,000 hours,	" 100	"	85 "
2,000 to 3,000 "	" 100	"	80 "
3,000 to 4,000 "	" 100	"	75 "
4,000 hours and over,	" 100	"	70 "
For residences			One cent per ampere hour.

Arcs.

8 o'clock lights,	each,	per	month		$8.00
10 " "	"	"			10.00
1 " "	"	"			14.00
All night "	"	"			17.00

For all consumers signing contract with the Company for electric lighting, 10 per cent. will be deducted from the above rates, by paying their bills at the Company's office on or before the 6th of the month. These rates are lower than those prevailing in any city of the Northwest where operative conditions as to cost of fuel and rates of wages are similar. The largely increased use of electric lights in this city during the past five months seems to justify us in making the present rates lower than those in effect previous to September, 1895, by from 15 to 33⅓ per cent., and if the generous use of same is continued we feel satisfied we can maintain the above low rates with mutual satisfaction to our customers and ourselves. We also call attention to the fact that this Company will continue the plan inaugurated by itself, of furnishing renewal lamps without cost to customers, which is done in no other city in the Northwest.

THE United Gas Improvement Company has closed a contract with the Consolidated Gas Light Company, of Long Branch, N. J., for a generating plant something in excess of one-half million cubic feet daily capacity. It is, of course, to be constructed in accordance with the usual well-known double superheater type of setting favored by the U. G. I. Company. It is the second order which the constructors have obtained from the Long Branch district, and the apparatus is to be put up to enable the proprietors of the Consolidated Company to carry out their scheme of distributing gas along the Southeast New Jersey coast, from Red Bank on the north to Point Pleasant on the south, the central works point to be Long Branch.

ON February 24th papers incorporating the Richmond Hill and Queens County Gas Light Company, of N. Y., were filed with the Secretary of State. The stated objects are "to make and sell illuminating and fuel gas, and to generate and supply electricity for Richmond Hill, Jamaica, Brooklyn Hills, Woodhaven and adjacent territory." The Directors are A. A. Forman and R. Boeklen, of Brooklyn, E. S. Hobbs and F. B. Case, Jr., of New York, and Jas. C. Forman, of Haverstraw. The capital stock is put at $250,000, and the projectors say that construction work will be commenced at once. The plant is to be located at a point between Woodhaven and Jamaica. The territory proposed to be supplied, which adjoins Brooklyn on its direct eastern boundary, it seems to us could be more economically served with gas through an extension of the mains of the East New York branch of the Brooklyn Union Company, or by the extension of the system of the Jamaica Company. The Boeklen process will be employed by the projectors of the new Company.

MR. F. L. PRICE, formerly Assistant Secretary of the La Crosse (Wis.) Gas Light Company, is now in the general office of the Northwestern Gas Light and Coke Company, of Evanston, Ills.

BY a decree of the United States Circuit Court, for the district of Little Rock, Ark., the mortgage held by the New York Security and Trust Company on the plant of the Pine Bluff (Ark.) Water, Gas and Electric Light Company was foreclosed, and the Court's Master in Chancery was ordered to sell the property to the highest bidder.

AT the annual meeting of the Franklin (N. H.) Gas and Electric Light Company the officers chosen were: Directors, W. F. Daniell, F. L. Morrison, M. Duffy and A. W. Sulloway; President, A. W. Sulloway; Treasurer, John P. Proctor; Clerk, Frank N. Parsons; General Manager, John P. Proctor. It was determined to hereafter only supply incandescent electric lights by meter rate.

MR. JOHN CALVIN HALL, a member of the Board of Directors of the Chelsea (Mass.) Gas Light Company, died at his home in Chelsea on the 18th of February. Deceased was born in Croyden, N. H., March 28th, 1833, and, since 1866, was in the employment of a prominent Boston wool-dealing firm—Messrs. Nichols, Dupee & Co. He was a member of the Chelsea Common Council in 1879–80, and served on the Chelsea Board of Aldermen in 1881–82–83. Among other positions of trust held by him were: Director of the Chelsea Savings Bank, Commissioner of the Chelsea Sinking Fund, and membership in the Veteran Firemen's Association. He was also prominent in local Masonic and social circles, and deservedly enjoyed the respect and regard of his acquaintances and friends. His immediate survivors are his widow, three sons and two daughters.

THE gas situation in Baltimore was complicated by the introduction, some days ago, in the lower branch of the Maryland Legislature, of two bills, the first of which proposes to repeal sections 338 and 339 of article IV. of the Code of Public Local Laws. This procedure, if sanctioned, would open the doors leading to the supply of gas in Baltimore by parties other than the Consolidated Company, as the sections named specify that, "No gas companies shall be formed in Baltimore city, Baltimore county or Anne Arundel county, except in the city of Annapolis. No gas companies chartered in any other counties of the State shall have the right to lay mains or sell gas in Baltimore city, Baltimore county or Anne Arundel county." The second measure is directed towards the repeal of section 341 of the aforesaid Public Local Laws, and the latter are sought to be amended to the point of declaring that no gas company in Baltimore shall charge more than $1 per 1,000 cubic feet for the gas supplied by it. The sentiment of the people interested in the gas trade of Baltimore is that the measures will fail of passage.

THE Philadelphia *Press* says that on February 20th the local Council effectually killed a new proposition to purchase the city gas works, the Council, by a decisive vote, declaring that "the gas works are not for sale." The matter was brought up in a communication sent by Dallas Sanders, G. H. Davis, H. C. Chapman, Christian Ax, T. C. Basshor, N. G. Nurmson, H. C. Turnbull, Jr., and O. E. Robinson, of Baltimore. The relators declared that it was proposed to form a corporation for the purchase of the gas works. They offered for the property, including all mains, holders, pipes, appliances, generating apparatus, and all other property and *privileges* connected with the manufacture and supply of gas in Philadelphia, the sum of $20,000,000, of which sum $250,000 should be paid within 15 days after the passage of the ordinance, approved by the Mayor; $4,750,000 within six months thereafter, at which time the purchasers would take possession of the works; the balance to be paid six months subsequent to the date of possessing, interest at 5 per cent. to be paid on the amount decided, from the date of transfer. The syndicate agreed to expend $5,000,000 in modernizing the works, and to furnish 22-candle power gas to the city, at a rate not exceeding 65 cents per 1,000 cubic feet, the price to the ordinary consumer not to exceed $1 per 1,000, except for fuel purposes. In the latter case the rate was to be 70 cents per 1,000, if a separate meter and connection were employed to measure and convey the supply. The city gas lamps were to be charged for at the rate of $10 each per year, the lighting table now followed to rule. After 10 years of ownership by the syndicate, the latter would pay into the city treasury the sum of 5 per cent. on the net profits, and after 15 years the premium would be increased to 10 per cent. The city might also name for its representation 2 out of the 15 directors that would direct the Company's affairs—the remaining 13 ought to be a lucky majority for the syndicate. At the expiration of 25 years the city was to have the right to buy back the plant, either for cash or city bonds, at the price originally paid, plus the amount expended in improvements, the value of the plant at the surrender period to be determined by experts. Patent rights and patents, however, were not of necessity to be reckoned in the determined value. The syndicate agreed to bind itself to offer its bonds for sale only by subscription through the public of the city of Philadelphia, but did not bind itself to keeping the said bonds in the custody of Philadelphians, until three generations of Philadelphians had seen the light. The syndicate further admitted that the City Council should have the power to fix the selling rates, such adjustment, however, not to be made oftener than once in three years.

THE proposition above outlined would undoubtedly be an excellent one for its proposers, and the JOURNAL would like to have a chance at the property bid for on the terms outlined. In fact, we would like to be in any deal that would put the cash purchasing value of the Quaker City gas works at one and one-half times the price named by the Sanders–Davis syndicate.

THE Committee on Manufactures of the Massachusetts Legislature has reported "leave to withdraw" on the petition for an act to "permit cities, towns, firms or corporations engaged in the making and selling of gas to buy from or sell gas to any other city or town, etc., engaged in its manufacture."

IT is again proposed to incorporate a Company for the supply of gas in Manchester, Va., which place should have had gas light years ago. This time it looks as if it would be "a go."

AT the organization meeting of the Directors of the Delaware County Gas Company, of Chester, Pa., the result reached was: President, W. S. McManus; Vice President, W. C. Gray; Secretary and Treasurer, L. A. Tucker.

THE Selectmen of Spencer, Mass., having negatived the claim of the Spencer Gas Company for damages to its main pipes, through the use by the local authorities of a steam roller, the case will be fought in the courts.

The Market for Gas Securities.

There was no change in the market for city gas shares, unless some realization in Mutual was the feature. The general situation is as it was a week ago. The Burns bill has some disturbing looks, but it will likely "go" as Mr. Sage says. He has had time to consider the growth of the grain, and ordinary cultivators of the field seem to think it is about time that he did his part towards opening soil. Brooklyn shares are strong. Chicago is steady, notwithstanding one or two vigorous bear drives, and it is cheap at the market.

Baltimore Consolidated did not suffer much from the appearance of Mr. Cunningham's proposed changes in the local public laws. The stock is cheap at anything under 60. The general market reflects the strength brought about by the increased sendout.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

March 2.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	157½	159
Central	500,000	50	150	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	211	216
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	220	241
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	39	40
Preferred	2,000,000	100	73½	74½
Bonds 1st 5's	3,500,000	1,000	100½	101½
" 1st Con. 5's	1,500,000	..	87½	89¼
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	77½	79½
Preferred	5,000,000	100	109	110
Bonds, 1st Mortgage, 5's	1,500,000	1,000	108½	110½
Yonkers	299,650	50	112	.
Out-of-Town Companies.				
Brooklyn-Union	15,000,000	100	86	..
" " Bonds (5's)	15,000,000	1,000	105¾	106¼
Bay State	5,000,000	50	18	25
" Income Bonds	2,000,000	1,000	..	30
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	..	80
2d " " "	3,000,000	1,000	51½	53½
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	68½	68¾
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	66½	67
1st Mortgage	1,065,000	..	94	95
Consumers, Jersey City	2,000,000	100	77	..
" Bonds	600,000	1,000	102	104
Cincinnati G. & C. Co.	7,000,000	100	203	..
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	41
Bonds (6's)	150,000	..	..	..
Consolidated, Baltimore	11,000,000	100	58	60
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	..	29
" Con. Bonds	4,312,000	..	71½	75
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	75	80
" Bonds	2,000,000	..	85	90
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	138	144
" Bonds, 6's	2,650,000	..	103½	105½
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	80	..
Bonds	1,000,000	1,000	89	92
Louisville	2,570,000	50	..	130
Laclede, St. Louis	7,500,000	100	24	24¼
Preferred	2,500,000	100	76½	77
Bonds	9,084,400	1,000	94¾	95
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	98	98
Bonds, 6's	4,000,000	.	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	46½	..
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	71½	72
St. Paul Gas Light Co.	1,500,000	100	68½	70
1st Mortgage, 6's	650,000	..	88	90
Extension, 6's	600,000	..	.	..
General Mortgage, 5's	2,400,000	..	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	65	68
Bonds, 5's	3,556,000	..	85	90
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WANTED,

Two Purifying Boxes, 10 x 8 x 3 ft., or 10 x 12 x 3 ft.

Also, a **Tar Extractor,** 6-inch connections.

Address, with particulars and prices,
1082-2 "A.," care this Journal.

DIVIDEND NOTICE.

OFFICE OF WELSBACH COMMERCIAL COMPANY,
40 WALL ST., NEW YORK CITY, Feb. 13, 1896.

The Directors have this day declared a quarterly dividend of two (2) per cent on the preferred stock, payable on March 10, 1896, to stockholders of record at the close of business Feb. 29, 1896. Transfer books of the preferred stock will be closed from March 2 to March 10, both inclusive. Checks will be mailed.

1081-3 EDWARD C. LEE, Treasurer.

WANTED,

By a young man of 20 years' experience, a position to take full charge of a medium or small sized gas works; coal gas works preferred. A worker in all branches of the business—manufacturing, construction, mechanical and clerical; 7 years' experience in pushing the gas stove business. Would like a works where plant and business need building up. Can furnish competent and thoroughly reliable references.

1080-4 Address "P. V. T.," care this Journal.

Position Wanted

As Superintendent of Gas Works or Gas and Electric Light Works.

Has been in the employ of the Long Branch (N. J.) Lighting Company as Superintendent for the last 11 years, and is a practical mechanic, thoroughly understanding the laying out and erection of plant and the making of coal and water gas. Best of references. Address CHAS. J. LUTHER,
1079-4 Box 142, Long Branch, N. J.

POSITION WANTED

As Supt. or Manager of a Gas Works or Gas and Electric Light Works.

Fifteen years' experience as Manager of Gas Works and six years Gas and Electric Light Works. Good reasons for wishing to change present employment.
1043-tf Address "Y. B.," care this Journal.

FOR SALE,

All the Stock, Free of Debt, of a Small Gas Plant in Ohio.

Address "BARGAIN,"
1081-2 Care this Journal.

Wanted, Immediately,

Several Thoroughly Competent Meter Repairers.

Address, stating experience, references and wages expected,
T. LITTLEHALES, Gen'l Manager Gas Co.,
1080-3 Syracuse, N. Y.

Consulting Engineer.

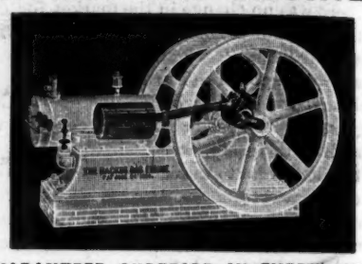
An experienced and competent Engineer, thoroughly versed in all details relating to the manufacture and distribution of gas, will act as Consulting Engineer to a few more companies. Concise, accurate, and up to date methods employed, insuring economical operations and increased dividends. Terms moderate. Address "A. B. H.," care this Journal.

The Output of Bear Creek Cannel Coal—

the only high grade Gas Cannel available in large quantity—has been increased. We are anxious to add to our long list of Gas Companies using Bear Creek Cannel, and will be glad to furnish details as to cost and yield.
1080-4 MACFARLANE & CO., Louisville, Ky.

Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.
Ammonia Concentrator,
Not Expensive. Write to
STROH & OSIUS, Pat'ees, or
Mich. Ammonia Works, Detroit, Mich.

BACKUS GAS ENGINES



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Agts. { Chicago Water Motor & Fan Co., 101 Lake St., Chicago. Michell & Co., - - 154 Congress Street, Boston, Mass.

Home Office, Backus Water Motor Co., Newark, N. J.

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N. S. WILLSON & CO., Attorneys at Law, Opp. U. S. Pat. Office. WASHINGTON, D. C.

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UNIFORMITY GUARANTEED.
ALL SIZES AND SHAPES.

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CHATTANOOGA, TENN.

BRISTOL'S RECORDING PRESSURE GAUGE

For Continuous Records of
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Simple in Construction,
Accurate in Operation,
Low in Price,
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Send for Circulars.
THE BRISTOL CO.
Waterbury, Conn.

Received Medal at World's Columbian Exposition.

Gas and Water Works Extensions.

PIPE LAYING OVER OR UNDER WATER A SPECIALTY.

Competent Divers for Submarine Work sent to any part of the United States.

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HERMAN POOLE * Chemical Engineer,

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Makes a Specialty of

PURIFICATION

And the Utilization of Waste Products in Gas Manufacture.

THE GREATEST IMPROVEMENT IN GAS LIGHTING
Has been made by
WILDER'S VOLUMETRIC GOVERNORS.
They control the pressure at the burner, and deliver the quantity for which they are set regardless of high or low pressure in the supply.
WELSBACH LIGHTS are fully controlled, and the governors soon pay for themselves by preventing the breaking of mantles and chimneys. Thousands are already in use. Orders may be given to the Welsbach Co., or sent to ourselves.
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COKE CARS for Gas Works,
TIP CARS for Carrying Ashes,
CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.
INDUSTRIAL RAILWAYS
Specially designed for handling material in and around
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WATER TUBE BOILER.

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Unequaled for the Economical Production of Very Dry Steam.
WE GIVE Liberal Capacity, Highest Efficiency, Absolute Safety and Thorough Workmanship.
WE SOLICIT the Critical Examination of the Mechanical Profession and the Steam-Using Public, and Your Trade.
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The HAZELTON BOILER COMPANY,
Sole Proprietors and Manufacturers,
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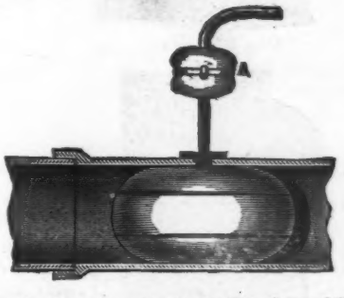
Tele., "1229-18th St.," New York.
Gen'l Office, 716 E. 13th St., N.Y., U.S.A.

Peerless Patent Improved Gas Bag


These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficiently inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

3-in.	Gas Bag,	each,	$0.60	12-in.	Gas Bag,	each,	$5.00
4 "	"	"	.80	16 "	"	"	8.25
5 "	"	"	1.05	20 "	"	"	12.00
6 "	"	"	1.75	24 "	"	"	17.00
8 "	"	"	2.65	30 "	"	"	27.50
10 "	"	"	3.75				

The Peerless Rubber Mfg. Co.
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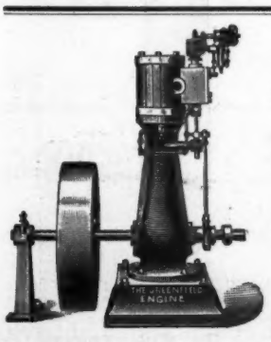

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Factory, 447 to 453 W. 14th Street.

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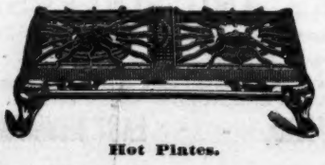
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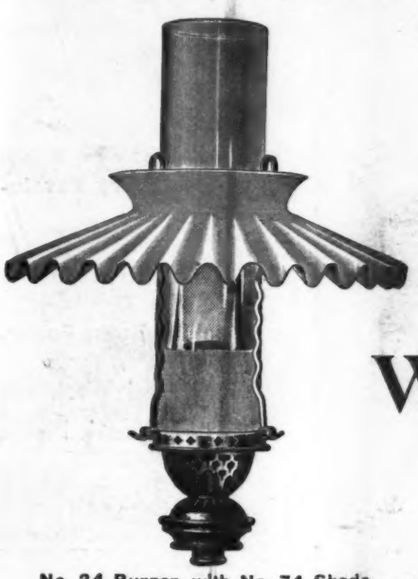
Hot Water Boilers.

The Improved

Welsbach Light.

No. 34 Burner, with Nos. 10 and 43 Shades.



No. 34 Burner, with No. 74 Shade.

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Owns, Operates, Buys and Leases Gas Works.

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Especially the Installation or Extension of Plants for the Manufacture of Gas from Caking Coal.

The attention of Gas Managers is particularly called to the many improvements in this method of manufacture instituted during the past fifteen years, and the extremely low cost at present of Coal Gas.

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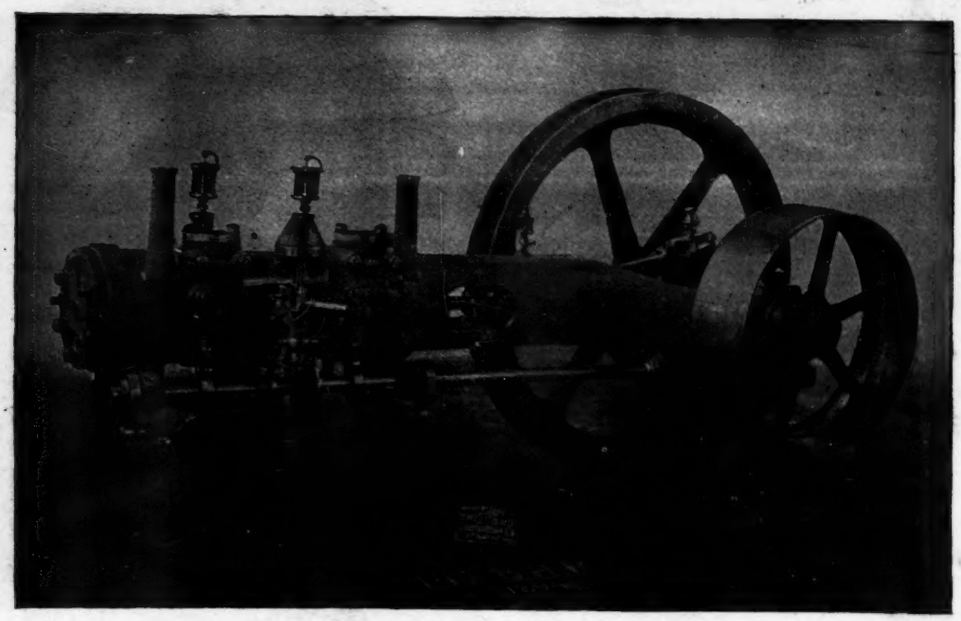
The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.



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Impulse Every Revolution.

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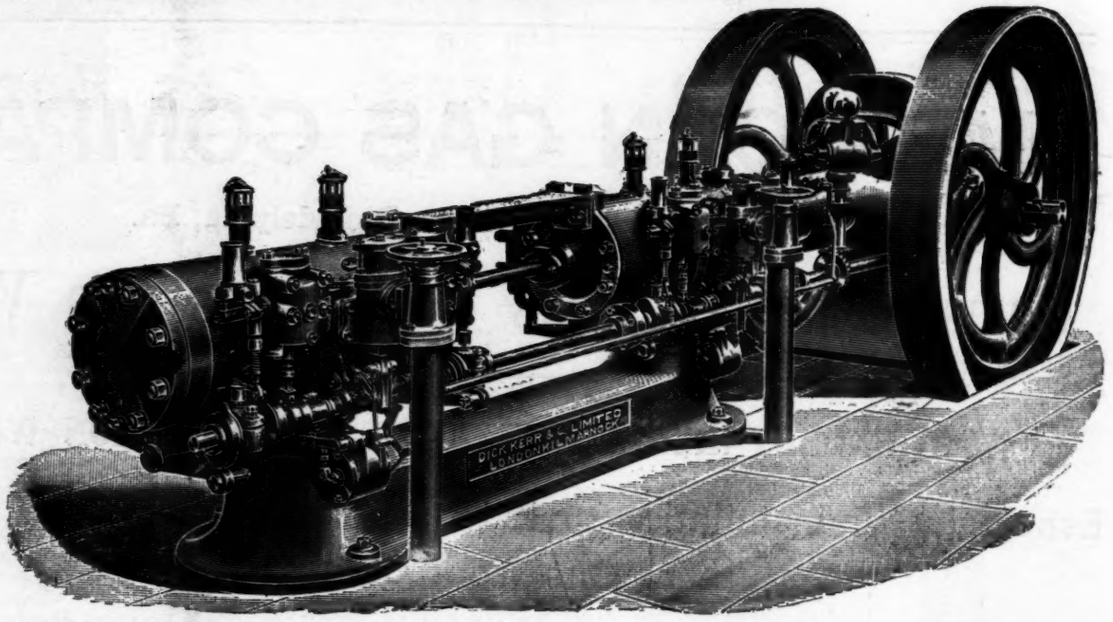
15 to 500 Horse Power.

For General Work and Isolated Electric Plants.

Tandem Cylinder. Impulse Every Stroke.

100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.



ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cylinder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

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Covers All.

52 Styles of Cookers.
54 Styles of Heaters.

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IS WORTH THE ASKING.

GEORGE M. CLARK & COMPANY, Makers, CHICAGO.

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Bray's Patent "Enamel" Gas Burners.

Bray's "Special" and "Adjustable" Burners

Are the Cheapest, Most Economical and Most Durable in existence, and will, at their REDUCED PRICE, save their cost in gas alone in forty hours' use.

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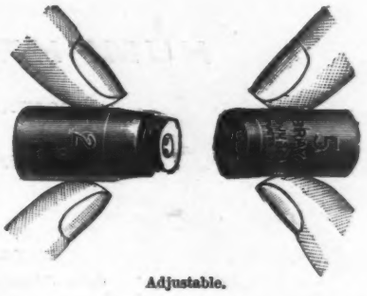
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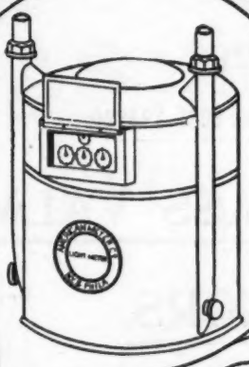

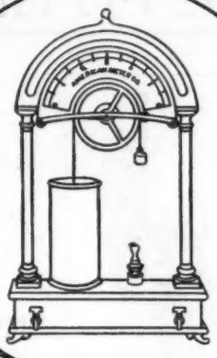

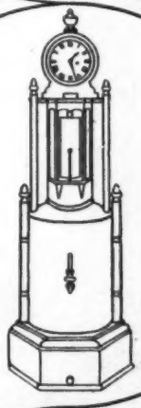

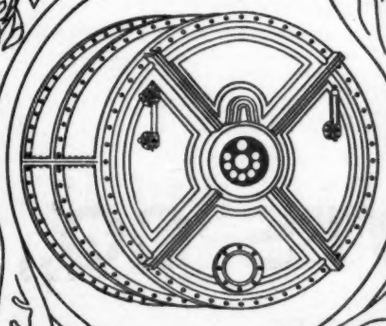

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CHICAGO, ST. LOUIS,

SAN FRANCISCO.

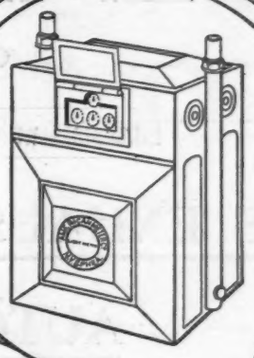
PUBLIC LIGHTING TABLE.

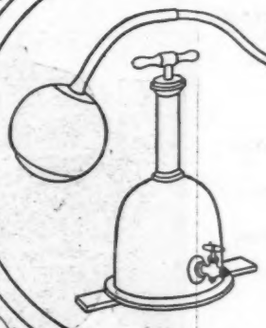
MARCH, 1896.

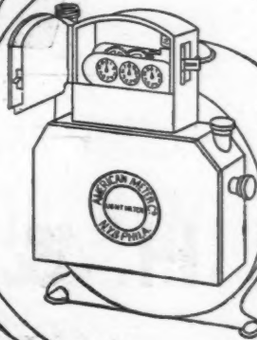
Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish.
				P.M.	A.M.
Sun.	1	6.30 PM	9.30 PM	5.30	5.45
Mon.	2	6.30	10.50	5.30	5.45
Tue.	3	6.30	12.10 AM	5.30	5.45
Wed.	4	6.30	1.20	5.30	5.45
Thu.	5	6.30 LQ	2.30	5.40	5.35
Fri.	6	6.30	3.30	5.40	5.35
Sat.	7	6.30	4.20	5.40	5.35
Sun.	8	6.30	5.10	5.40	5.33
Mon.	9	6.30	5.10	5.40	5.35
Tue.	10	6.30	5.10	5.40	5.35
Wed.	11	6.30	5.10	5.40	5.35
Thu.	12	6.30	5.10	5.50	5.20
Fri.	13	6.30 NM	5.10	5.50	5.20
Sat.	14	6.30	5.10	5.50	5.20
Sun.	15	6.40	5.00	5.50	5.20
Mon.	16	6.40	5.00	5.50	5.20
Tue.	17	6.40	5.00	5.50	5.20
Wed.	18	9.40	5.00	5.50	5.20
Thu.	19	10.40	5.00	6.00	5.10
Fri.	20	11.40	5.00	6.00	5.10
Sat.	21	12.40 AM FQ	5.00	6.00	5.10
Sun.	22	1.30	4.50	6.00	5.10
Mon.	23	2.20	4.50	6.00	5.10
Tue.	24	2.50	4.50	6.00	5.10
Wed.	25	3.20	4.50	6.00	5.10
Thu.	26	3.50	4.50	6.10	4.55
Fri.	27	No L.	No L.	6.10	4.55
Sat.	28	No L. FM	No L.	6.10	4.55
Sun.	29	No L.	No L.	6.10	4.55
Mon.	30	6.50 PM	9.40 PM	6.10	4.55
Tue.	31	6.50	11.00	6.10	4.55

TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142.10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00







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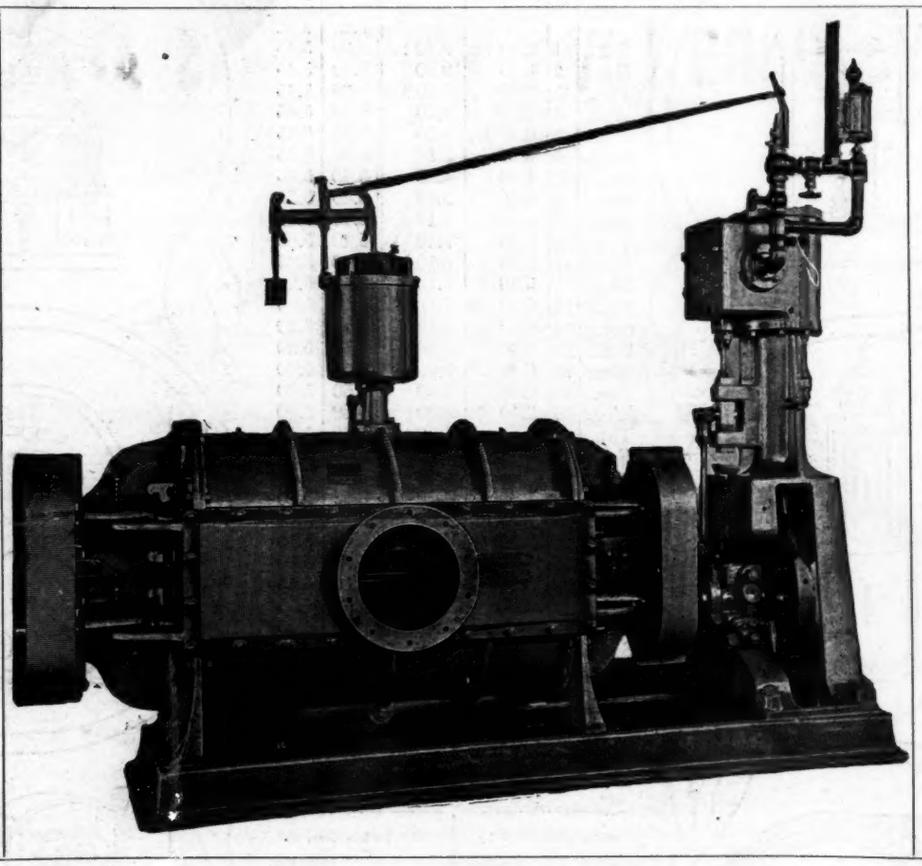

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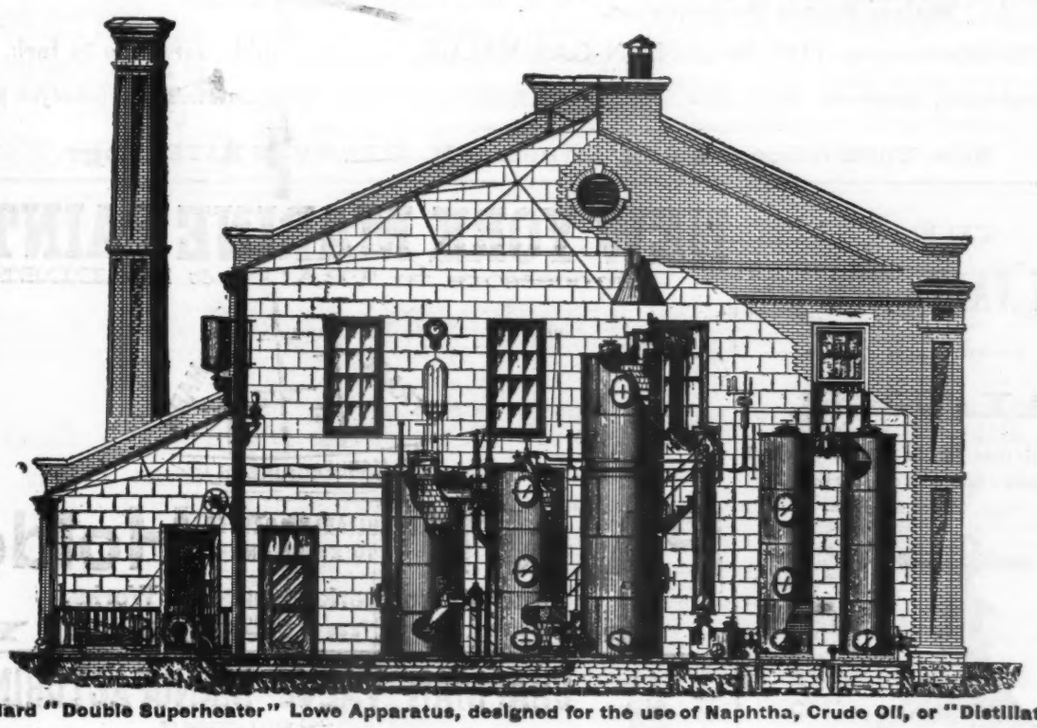

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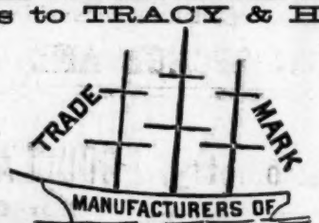

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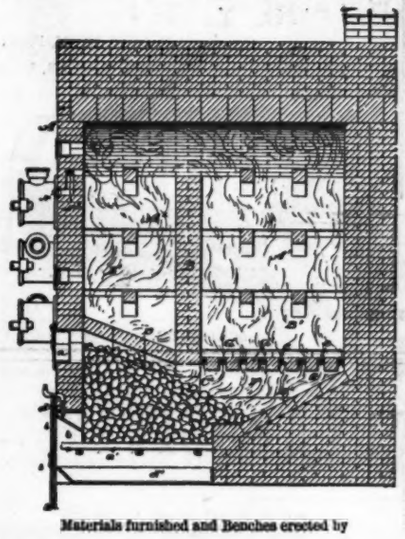

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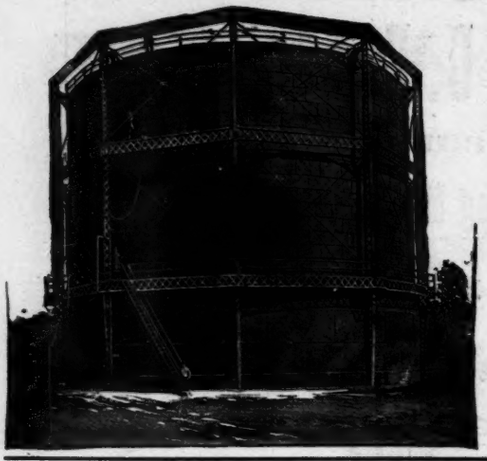

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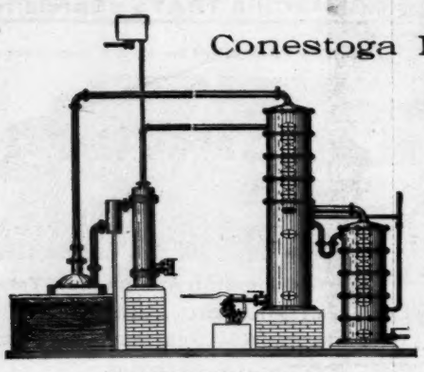

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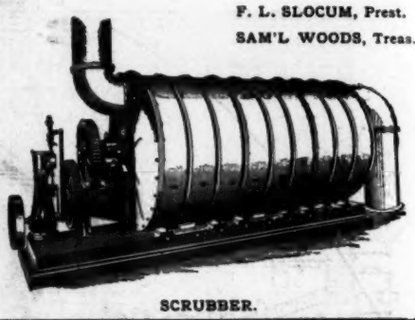

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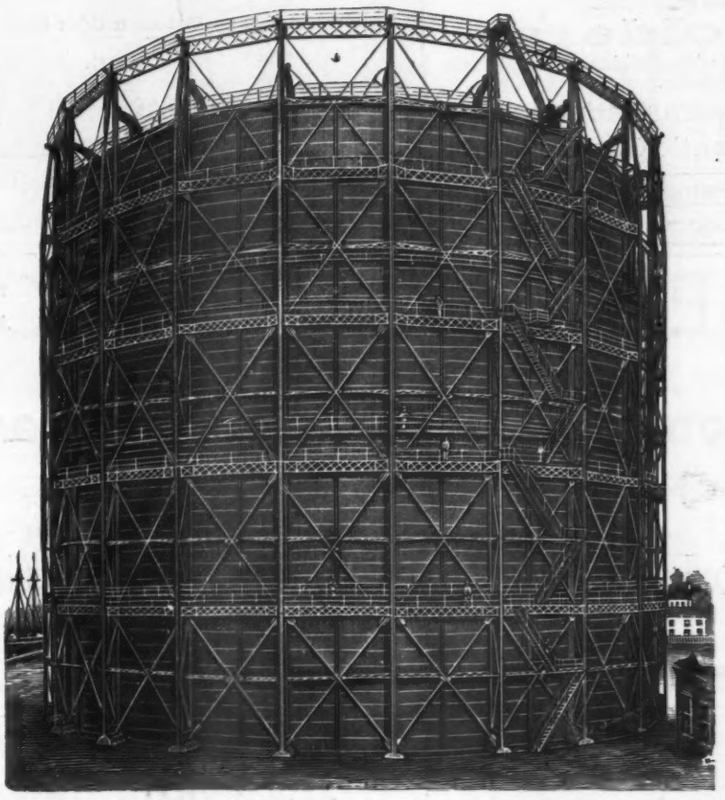

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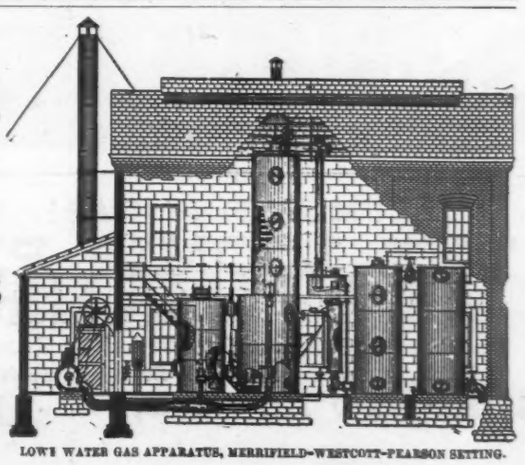

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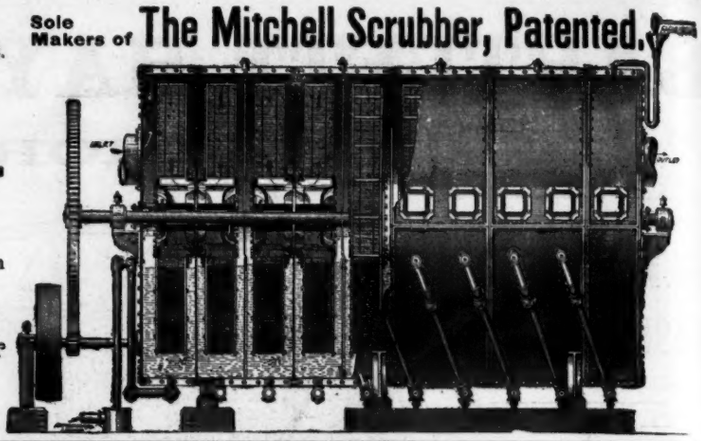

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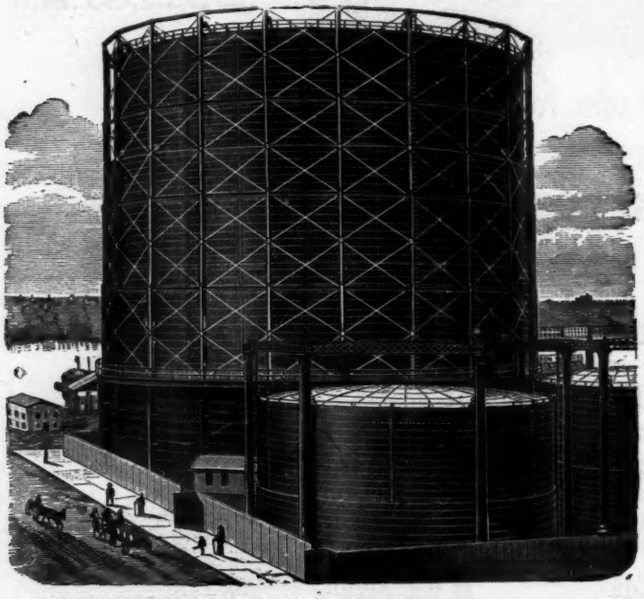

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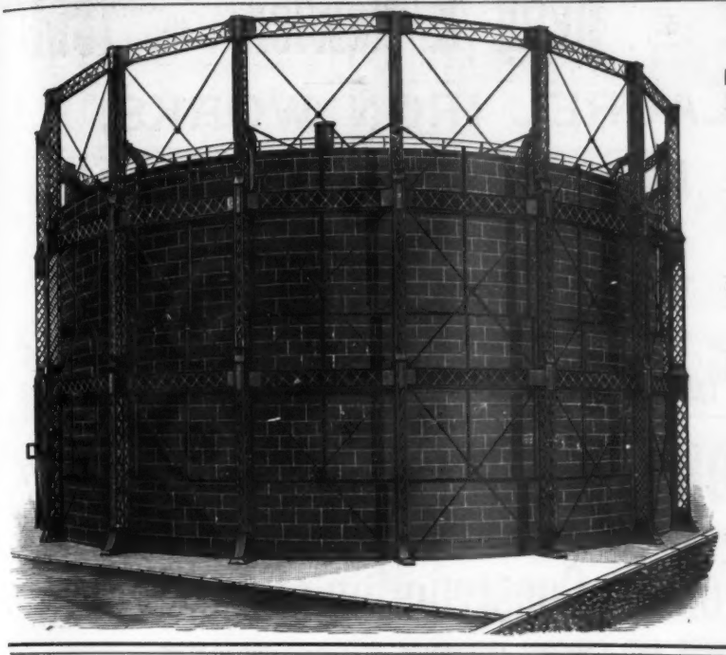

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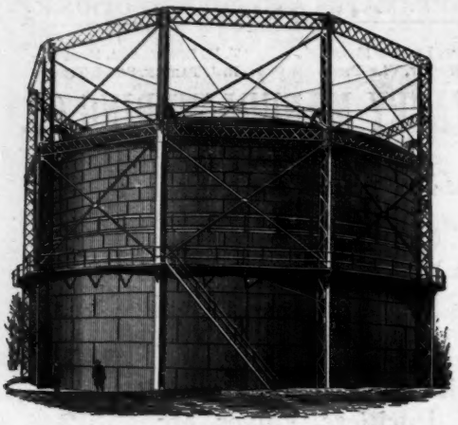

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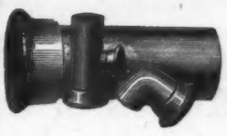

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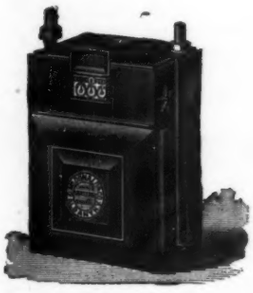

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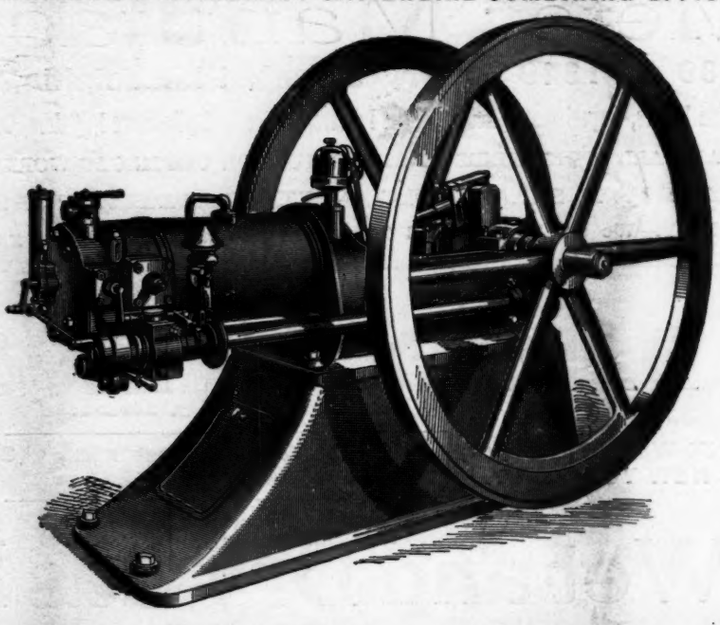

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